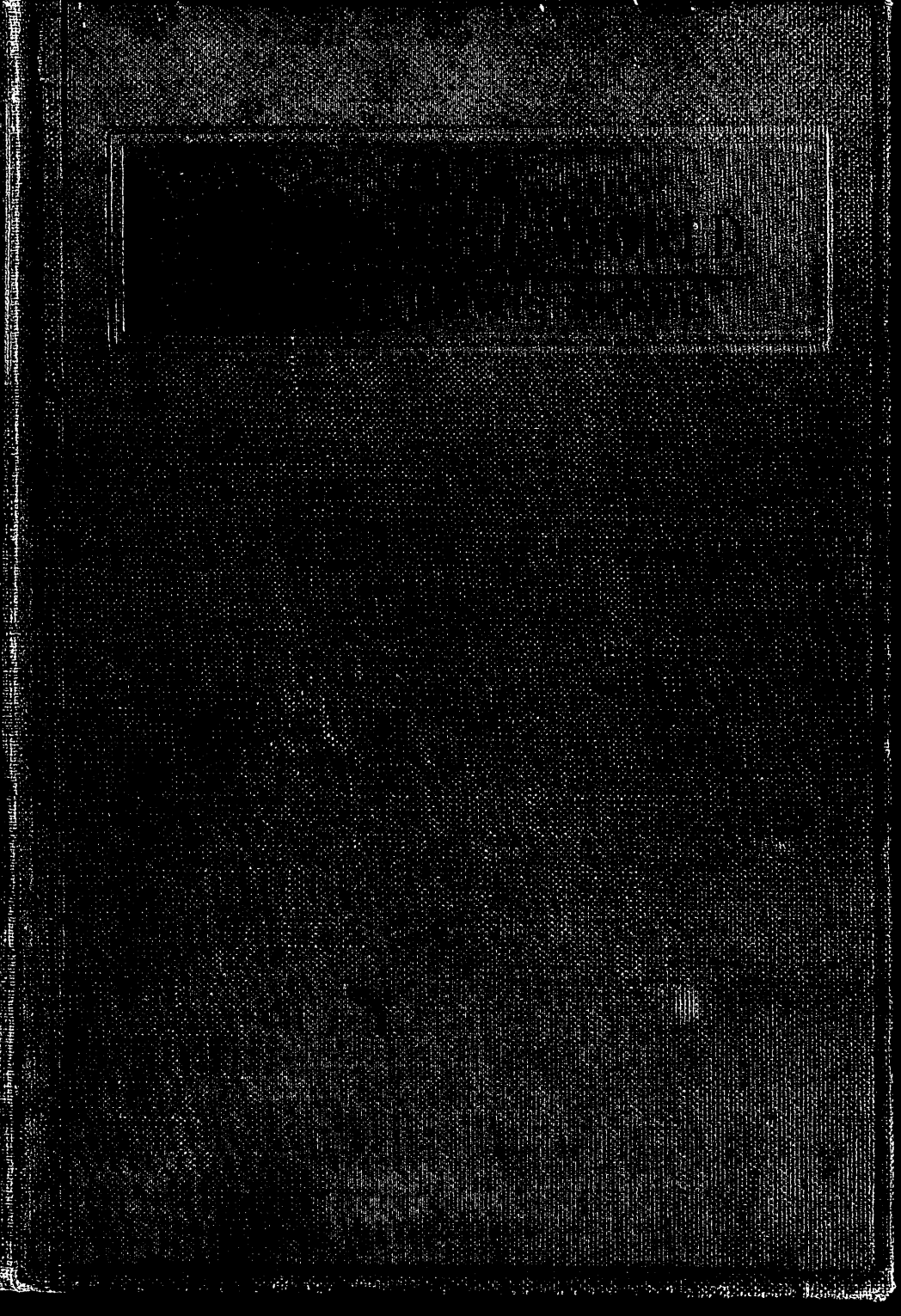




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**Our
Wonderful World**

BY
EMERY LEWIS HOWE

With Class Room Adaptations by
JEAN GERTRUDE HUTTON

ILLUSTRATIONS BY THE AUTHOR



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**DEDICATION
TO MY DAUGHTER MARGARET**



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TO THE BOYS AND GIRLS WHO READ THIS BOOK,
GREETINGS:

THESE pages have been written for your pleasure and to help you know and enjoy the world about you. You may think of this book, if you wish, as a passport that allows you to travel and come to know many new friends. Most boys and girls love to go on journeys; they feel that far too little opportunity for travel is theirs. They read of marvels in many lands, and wish to go "these wonders to behold." Here is one way in which you may travel in new lands that lie near at hand. Here you may discover things as wonderful as in places far away.

If you object, and say that one cannot travel far on foot, or find interesting wonders near at home, let me remind you of what one of our own great men once said. He wrote that one could find in his own dooryard, no matter where this might be, as great marvels as can be seen anywhere, *if only he had the eyes to see them!* It is quite certain that many travelers in lands far off do not have seeing eyes, and come home from long journeys with little gain. Which would you choose to be, a person staying near home with a seeing eye, or one going a long distance with blind eyes?

I said at the beginning that you might think of this book as a passport. You know travelers in foreign countries need a paper called a passport to gain entrance into the lands of other peoples. These pages will show the way to enter into some

territories that are strange to you. I hope they will help you to find out just how to conduct yourself so that you will be pleasing to the inhabitants whom you are visiting. Perhaps they will help you to know and understand them all a little better.

There is another way in which you may think of this book. You may call it, if you please, a letter of introduction. If you are going to a new place, some friend may give you a letter to introduce you to someone who lives there. The letter does not tell you about the person; it just introduces you; it starts the acquaintance for you. You must do the rest of the getting acquainted yourself. You must learn for yourself what the stranger likes, how he lives, what things he has to teach you or show you, and what work he does.

This book will introduce you to some creatures whom you may know slightly, but most of the getting really acquainted with them is left to you. This will be the best part of what the book does for you.

Sometimes the stories will give the facts for you to see with your own eyes, and to think through by yourself. Sometimes you will see the wonders of God's world through the eyes of a boy and a girl who live in America, Don and Ruth Harris. Don and Ruth are just like you, wide awake, thinking, interested, asking questions, and trying to find out all sorts of new things. You will, I hope, like to find out things with them.

As you use the book, do not be like the travelers of whom I spoke: do not shut your eyes; do not shut even *one* eye! Do not feel sure you have found out all there is to know when you have looked

very sharply with your two real eyes at anything whatever! Put your mind's eyes at work, and keep them busy! Ask questions when you need to ask them. Most of all, think, and then *think*, and then THINK again! Try to see how one story fits into another. Try to see how one fact in God's world fits, not into one other fact, but into *all* other facts. You may not see just how this is at first, but the more you think and the more you find out, the more you will be sure that this is true.

For an illustration: Perhaps you ate a fine ripe peach for lunch to-day. After you have read the seeds story, you will think that the peach came to you partly because it did its seed up in such an attractive package, and you may suppose that you have learned all this book has to tell you of the peach. Let me set you a question or two!

How did the earthworms help the peach you ate?

Do you think it possible that the birds had anything to do with your peach?

Could beavers, dogs, or horses, have helped grow the peach?

What did the skyland helpers do for it? How many of them may have helped?

Did ants, or bees, or butterflies, have any share in the work?

Suggest a way in which an old glacier may have helped.

Too many questions, do you say? No, no! It is questions that make study interesting. It is by searching for the answers to questions that you learn new facts of interest and use. So set yourself to work; enjoy your book; but, better, enjoy the wonders of your own back yard; get acquainted

with the birds and the insects about you. Learn of the animal friends that live near you. Look to the skies, and get to know the stars by name. Seek in the common materials around you for wonderful stories; and you will find them on every hand. You will indeed "speak to the earth, and it shall teach you," for you will find that "in all the hand of the Lord hath wrought."

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E. L. H.

PART I

BACK-YARD NEIGHBORS



LESSON I

BUSY PLOWMEN

WHAT a fine morning after last night's shower! The grass is fresh and green. The flowers are decked with sparkling dewdrops. Bees are humming. Birds are busy. The rain-washed earth has a delightful smell. It is just the time to make a friendly call and become better acquainted with some of our good neighbors.

Do you say it is too early to visit Mrs. Brown? You are sure that Mrs. Smith is too busy to be interrupted just now?

You quite misunderstand me. I am not planning to go with you to see friends who live in houses like yours or mine, or to call on neighbors who talk as you and I talk.

The neighbors I am thinking of live in a very simple way, generally quite out of our sight. They do their work with no thought of what it means to us. But they are following the laws of the heavenly Father, who made them, as he made all things. In countless numbers, and for countless years, these helpers have been carrying out their part in God's great plan, though we seldom stop to think how much of our comfort and pleasure we owe to these busy workers who toil in the way the Creator has set for them.

I see you do not know what I am talking about. Come with me along the garden path, and we may

chance upon one of these busy plowmen; we will stop and get acquainted with him.

Ah, here is one! Let me introduce Plowman Earthworm, a tireless worker. What? you thought it only a horrid, wriggling worm? You supposed it good for nothing but fish bait? Had the earthworm not done his task well, I suspect you would have had no breakfast. It is due to his work very largely that you could enjoy that juicy lettuce, those fine strawberries, the nice cereal and the rich yellow milk, or, for that matter, any of the vegetable food you ever ate! Did you really think that an earthworm had filled the purpose for which it was put into the world when it had helped you catch a fish dinner? No, indeed!

But you need not feel too much disturbed that you have not known sooner the very important work of Plowman Earthworm. The wisest men living did not know much about these plowmen a few years ago. Then Charles Darwin, a great English scholar, began a very exact and painstaking study of these small creatures. Mr. Darwin measured off plots of ground, and counted the earthworms he found in each; he counted the burrows he found; he counted the leaves the worms carried down; he weighed the earth thrown up by them. In these ways he learned many most interesting things about these busy helpers who work out of sight and so quietly that we seldom think of them, except when we wish to go fishing!

You probably know that many animals are important soil builders. What would your answer be if I were to ask you to name the most important of them all? I am sure you would speak of a half

dozen before you would think of putting Plowman Earthworm at the head of the class. But that is just what Mr. Darwin answered! He concluded that the earthworm does a vast deal of soil building, of soil draining, of opening soil to the air, and of making passages through which the tender roots of growing plants can easily find their way, and where they can get their food. Besides this, the worms chew up bits of leaves and blades of grass, and take them to the burrows under the surface. All of this lightens the soil, and makes it more porous. The worm breaks up the soil exactly as does the farmer's plow, only much more perfectly and completely.

Perhaps some one has told you that the plow was one of the first tools invented by man. You certainly know that it has been one of the most valuable tools he has ever had. At first the plow was probably nothing but a crooked stick, or a forked branch; and you have all seen the pictures of the fine steel plows and tractors that the farmer of to-day uses. Sometimes one or two horses will draw the plow. Often, on large farms or ranches, four horses will be used. Many farmers to-day have put aside the horse-drawn plow for one that is driven by gasoline.

Are you thinking of these great plows, and wondering how a soft creature like an earthworm can force itself through the hard soil and turn it up to the air and the sun? It surely must be very difficult. Indeed, it would be impossible if the worm tried to force itself through, but this is not the way it takes—it eats its way through. Instead of rolling up little pellets of earth and taking them to the

surface, as do many of the insects, the earthworm swallows the earth. Then, in a gizzard much like the one you have seen taken from the Thanksgiving turkey, only very, very much smaller, the earth is ground up fine. Out of the ground-up mass the earthworm takes the decayed vegetable matter for its food. The rest of the earth is cast out in the form of little mounds or pellets. You can find these almost any morning, in the grass, or along the garden path.

Of course you are ready to say that the amount of soil building that can be done by a few earthworms is so small that it is hardly worth counting. I suspect that the worms themselves, if they had minds and could think, and if they could once see how very big the earth is, especially when measured by earthworm measures, would grow quite discouraged, and be ready to say, "It never, never can be done!"

But you are overlooking one fact, and that is the number of earthworms that are all the time plowing, plowing, plowing. You remember Mr. Darwin counted the earthworms he found in measured pieces of ground. In this way he was able to make a pretty good guess as to how many worms might be found in any section. How many do you suppose he figured lived in an acre of ground? Five hundred? A thousand? Perhaps as many as five thousand? All wrong! He figured that there are more than fifty thousand in an acre of ordinary ground, and perhaps in rich land there may be a half million to an acre.

More than this, earthworms seem to be found in most parts of the world. They are at work all

the time. Our farmers can plow only when there is little or no snow, and when the ground has just the right amount of moisture. Not so Plowmen Earthworms! When it is warm and moist they stay near the surface. Let the weather turn cold and damp, and do you suppose they take a rest? No, indeed! They simply eat down deeper, where the wet and chill cannot reach them, and keep on plowing.

You can see that a half million creatures, even as soft and weak as earthworms, can accomplish a great deal of work on an acre of ground, if they are always at it. Recall that Mr. Darwin weighed the earthworm castings he gathered up on measured parts of the land, and you will see how he could figure the amount of soil the worms would deposit in a year. You will not dare guess this time, so I will tell you that he estimated that as much as ten tons might be cast out in a single year. That is so much that you can hardly imagine it. Perhaps you can figure how many boys or girls as heavy as you are would be required to weigh ten tons, and you will have an idea of the weight of earth the worms throw out.

You must remember that the castings from the worms are soil ground up very fine, and this makes the best fertilizer. When some parts of the earth have as much as a fifth of an inch of this deposited over it in a year, do you not think it is worth a great deal? Do you think there is any truth, then, in the old notion that more worms are found in rich soil than in poor soil?

Did you ever find in an old pasture a stone that was nearly buried? How do you suppose it came

to be so nearly hidden? I often saw such stones when I was a child, and wondered if they had sunk deep into the ground just because they were so heavy. But when I turned them over, I found they did not weigh so much as I had thought. It was a long time before I found out that the busy Plowmen Earthworms had been burying the stone! First, as you can see, they worked under the stone. As they hollowed out little tunnels, and opened up the soil, the stone would sink a bit deeper. Then the worms would deposit their castings around the stone, and so build up the earth about it. When this had gone on for a number of years, the stone began to sink out of sight.

As you will learn in a later lesson, all soil is made from rock that has been broken into bits. This takes many long years, and many workers have a part in the process. Wind and water, frost and sun, all help. There are other helpers, too, and, of course, you will not be surprised to find the earthworms are among them. How can they work on rocks? Part of the rock-breaking comes through the action of acids that are made when vegetable matter decays. When the earthworms open and loosen the soil, they make the passage for these acids easier, and give channels that let them trickle down to the rocks. In this way the worms really aid in breaking up rocks on which their soft bodies could have no effect.

If you look very closely at the body of one of these little plowmen, you will find no eyes at all; of what use would eyes be to a creature that spends most of its life under the surface of the earth, in the dark? Eyes would be very troublesome, in

fact. Nor will you find any true brain, though there is a small nervous system, a central nerve spot, with a chain of smaller nerve spots extending through the body. Feet, which you would suppose very useful to a plowman of any sort, are also wanting. Instead, the earthworm has four double rows of spines set into the rings of which the body is made. These help the worm in moving, and are used to cling to the burrow for safety when you are trying to pull out of the earth a worm for your bait can, or when a hungry robin is looking for his breakfast.

Can you think of any creature in all God's wonderful world that does a bigger or more important work with as few and as simple tools as belong to the earthworm? Only a worm, working blindly in the dark, without noise, without confusion, persistently and patiently burrowing its way through the darkness and the damp! It is a simple, quiet, and an unseen part that our little plowmen play. Humble as it is, it is a part of God's great plan for the good of all his creatures. All plant and animal life is benefited by the work of the worms; and man, with all his intelligence and skill, would find it hard, if not entirely impossible, to accomplish the task which is so well done by these helpers.

When you next look at an earthworm and when you remember how this small and seemingly unimportant creature has been chosen to do so vast and important a bit of work, perhaps you will think of God's choice of the weak things to put to shame the things that are strong. And maybe after thinking about all this we shall all be a little

slow to think of anything in God's creation as little or weak or of no account.

An experiment:

Fill a small box with soil, and place three or more earthworms on top of this. Cover the box with a lid. When the worms have burrowed beneath the soil, scatter a little grass, and a few leaves, both dry and fresh, on the surface. Observe from day to day, and record in your notebook what the worms do. Sprinkle the earth to keep it from getting too dry. Care for the material for five or six weeks, and note if vegetable mold is formed.

Something to do:

1. Draw a picture of an earthworm.
2. Learn a little more of the earthworm's story. You will find it in the encyclopædia, a nature book, or the *Book of Knowledge*.
3. Write or tell the story of "The Earthworm's Help."
4. Find, if you can, places where earthworms are at work, and examine the worms. Do you find their burrows or tunnels in the soil?

To learn: 1 Corinthians 1. 27; or Zechariah 4. 10a.

God chose the foolish things of the world, that he might put to shame them that are wise; and God chose the weak things of the world, that he might put to shame the things that are strong; and the base things of the world, and the things that are despised, did God choose. —1 Corinthians 1. 27, 28.

LESSON II

ANT WORKERS

I

"MOTHER, mother," called Ruth, in great excitement, "here is a line of ants running across the floor."

"And then going up the wall," added Don.

"Dear me! we can't allow that," said mother, coming to look. "They must have found something they like to eat. Let us follow the line and see where they are going."

"Along the wall to the door, then into Ruth's room—and see! up on your table and into your candy box, Ruth!" cried Don, as he traced the line of busy ants.

"The horrid things!" exclaimed Ruth, peeping into the candy box, where a bevy of little black ants were swarming over the bonbons. "How did they ever find my candy, and how did they get into the box?"

"You did not put the lid on well," said mother, "and as ants send out scouts to look for food, they very soon found such a treasure as your candy. You know how careful I am to keep the sugar, syrup, and other sweet things in the pantry in tightly covered containers."

"I wish they had let my candy alone," said Ruth, busily removing the intruders, "but I must say I think they were clever to find it."

"Mother," asked Don, "why have these ants no

wings? I am sure that those I looked at the other day in the yard had wings."

"Those were father and mother ants," replied mother. "These are worker ants. At certain seasons of the year the father and mother ants come out of the nests in great numbers, and fly away together. When the mother ant comes back she begins to dig her burrow, or nest, in the ground. Here she will live all the rest of her life; never again will she need her wings. As they are very much in the way in digging, she does a strange but sensible thing—she bites them off!"

"Ugh! doesn't it hurt?" asked Ruth.

"Probably not," replied mother.

"Did these worker ants bite their wings off too?" asked Don.

"No," said mother, "they never had wings. They have always been workers, and you may think of them as soldiers, nurses, milkmaids, undertakers, diggers and engineers, or grocers, according to what they do."

"Oh, mother, is it a fairy tale you are telling?" asked Ruth.

"It sounds like a regular city," laughed Don.

"It is not a fairy tale, and it is much like a city," replied mother. "Ants are called social insects because they live in companies, and the wonderful way in which they divide the work of the colony and carry on their affairs has made some people almost sure that they think and reason."

"Do tell us about it," urged Don. "I would like to hear about the soldier ants."

"I'd rather hear about the nurses and the milkmaids," said Ruth.

"There is time to tell you part of the story," smiled mother. "First, you must understand there are nearly as many things to be done in an ant town as there are in a man town, and the ants go about it all with much order and what seems like very good sense. There are soldiers who guard the colony; perhaps you might think of them as somewhat like our police. There are those who go out to hunt for and bring back the food; I was thinking of them when I spoke of grocer ants a minute ago. Of course they do not sell the food, but they surely supply it. Then other ants dig the tunnels and lay out the runways, or burrows, and sometimes these are very elaborate, so we may indeed think of the ants who do this work as engineers. Dead ants are taken out of the burrow by other workers and are buried; so you may think of the ant colony as having undertakers."

"And the milkmaid ants, mother?" reminded Ruth.

"That does sound like a fairy tale, but it is not," assured mother. "Ants really keep a little creature that they use much as man uses cows. If you will bring the magnifying glass from the library table, Don, perhaps we can see a 'cow' on the rosebush here."

Mother selected a leaf or two from the bush, and Don, looking at them through the glass, exclaimed:

"Why, there is one of those little plant lice that makes your rosebush all sticky."

"Is that the ants' cow?" asked Ruth, peering in her turn through the glass.

"Yes," said mother, "that is what you may consider it. Some people call these wee creatures plant

lice. Others speak of them as the green fly. The true name is aphides. There are many kinds of aphides, just as there are many races of people—Russians, Indians, English, or French. Your glass is perhaps not strong enough to allow you to see clearly the mouth of the aphid, but if you will look at the enlarged drawing of one that you can find in the encyclopædia, you will see that it is just the right shape for piercing the leaves and sucking the sap. That same drawing shows two little spikes at the end of the body. Some wise men say when the ant wishes to ‘milk’ a ‘cow’ it strokes with its feelers these little spikes and the sides of the aphid. Then drops of a sweet sticky substance ooze out. Other wise men say the aphid manufactures the milk within its own body, and secretes it as the bee does the honey, and the ant simply gathers it up.”

“Oh, mother,” said Ruth, “I wish I could see an ant milk her cow!”

“It is an interesting performance to watch,” agreed mother; “and if you are patient, you may see which is correct. The ants take the best care of these little cows. They feed them well. Some people say that the aphides tell their caretakers when they are hungry by patting them. Sometimes the ants build a little shed of a sort to protect the cows. They handle them gently, and take them to feed on the sort of food the aphides like best.”

“This rose leaf is all sticky,” announced Don, who had been running his fingers back and forth over the leaf while mother talked. “What makes it so?”

"It is the honey-dew from the aphides," replied mother. "Of course it hurts the leaves to have the sap sucked from them by the hungry little aphides, but almost as much harm is done by the honey-dew, for it clogs the pores of the leaves. The dust settles in it too, till, after a time, the poor leaves cannot breathe at all, and the bush may sicken, or even die."

"Do aphides live on any bushes besides the roses?" asked Don.

"Indeed they do!" replied mother. "If it were only the roses they live on, perhaps it would not be so bad, though we should miss our lovely blooms. But each kind of aphid has its favorite food. Some of them will thrive nowhere but on a cabbage plant. Others prefer to settle down on beans. Some may choose a grain or a fruit or lettuce, but all of them act in the same way. One sort, the kind that settles only on corn roots, does so much harm that, if nothing were done about it, you soon would have no corn muffins for breakfast!"

"Oh!" cried Don. "I shouldn't like that at all, mother. Do tell me what can be done, and I'll help."

For answer, mother searched for a minute among the leaves of the rosebush and then came back to open her hand slowly before the eyes of the children. On the palm lay a little bug with a red back prettily marked in black.

"A lady-bug!" cried Ruth.

"But what can a lady-bug have to do with ants and their troublesome cows?" demanded Don.

"That is just what a great many men asked a great many times," replied mother, "and the answer at first was always, 'Nothing!' But some

men were not sure this was the right answer, and they carried on very careful experiments with ants and aphides and lady-bugs, and by and by they learned the whole story."

"Do tell us, mother," urged Don.

"These men," answered mother, "found that the lady-bugs lay their eggs on the plants where the aphides live. Why? Because lady-bug eggs change or hatch, not into lady-bugs, but into little larvæ whose favorite food is aphides. As soon as they hatch they begin to eat aphides, and when they have eaten all they possibly can hold they change into what are called *pupæ*. After a little, they change again, and then they are lady-bugs."

"How many aphides can a lady-bug eat?" asked Ruth.

"It is supposed that a good, healthy lady-bug with a growing appetite will eat about forty aphides in a day and keep it up for four or five weeks. But this is not all. The mother lady-bug may lay as many as fifty eggs every day. These eggs will hatch into larvæ, or hungry little grubs, in anywhere from three to six days. You do not need to take your paper and pencil to find out that they make way with enough aphides to really count!"

"Hurrah for the lady-bug!" cried Don. "I always thought her a cunning, clean little creature, but I did not know she is such a useful one! I will be more careful than ever not to hurt one after this!"

"You may well be," answered mother, "for she is far more useful than I have had time to tell you. Owners of California fruit orchards and orange groves, growers of cabbage, lettuce, peas, corn, grain, and fruit of many kinds, all depend on the

busy little lady-bug to fight the aphides for them and to give their crops a chance to grow."

"Where do the little aphides come from in the first place?" queried Ruth.

"They hatch in the spring from eggs laid in the fall on the chosen food plant. Then these aphides produce more aphides like themselves in about two weeks, and these aphides in turn produce others. This keeps up all summer, when the late aphides lay eggs that can pass the winter without the food that would be needed for creatures like themselves."

"And where do the ants come in?" asked Don, interestedly.

"The ants are on the lookout for these eggs, and take them to their nests. They know that their future supply of honey-dew depends on the number of eggs they find, and the care they give them, so they tend the eggs carefully, and when the aphides hatch they feed them and watch over them much as grandfather looks after his herd of fine cows."

"And the more ants there are, the more cows they need," said Don.

"Exactly!" replied mother. "Ants produce a vast number of eggs daily, which soon grow into ants. The colony needs more and more food as it grows in numbers, and honey-dew is a favorite food. So it is no wonder ants take great care of their cows, and give them every chance to grow well and to increase in numbers."

"I think the ants are very wise and clever," said Ruth, "but I do not think they are very good neighbors. They are not like the earthworms; they do not help at all. They do not do as much as the spider. Aren't they any good at all, mother?"

"Remember, my dear," replied mother, "that they were created by our heavenly Father, and that 'in wisdom he has made them all.' Perhaps you have not found out all that is to be learned of the ants. If you knew all about them, you might wish to change your opinion of them. In God's great plan for his wonderful world, every little creature as well as every big one has a part to play, a work to do. Suppose you and Don try to find out before our next story time what service these little neighbors have to perform."

Something to do:

Make a study of the ants and their ways. One method is this:

1. Find an ant hill, and drive a spade into one side of it, lifting it and thus turning over the dirt of which the hill is made. With a large spoon lift a quantity of the earth of the hill, together with the eggs, babies, queens, and workers, into a wide-mouthed jar.

2. Place a brick or a flat stone in the middle of a large pan of water. On this put a slate or a flat board. Pour the contents of the jar on the slate or board, and smooth it down. Cover with a sheet of glass of the same size as the board, putting a thin board over the glass to shut out the light, as ants prefer to work in the dark.

3. Place some particles of food on the board. If the ants are left overnight, a reconstructed nest will probably be found in the morning, and it will be possible to observe the colony at work. Make sure that the pan is large enough, and the water deep enough, to prevent the escape of the ants.

To learn: Proverbs 30. 24-28.

For in him were all things created, in the heavens and upon the earth.—Colossians 1. 16.

LESSON III

ANT WORKERS

II

"I HAVE found out one good thing the ants do," began Don, eagerly, as soon as he had placed the cushions in the big swing for mother. "They stir up the earth, loosen it and make it fine, something like the earthworms."

"Father helped me find another service," added Ruth at once. "He read from one of his big books about Sir John Lubbock, who learned ever so many things about ants. One day when he was watching a nest he counted twenty-eight dead insects brought in in just one minute. Father says that disposing of these dead bugs is a real service."

"What do they do with the insects?" asked Don.

"Eat them for meat, just as we eat the game our hunters bring in," said Ruth, very promptly.

"Why, the Bible is just right, then," cried Don. "What was our verse? Let me see! Yes, I have it!

'Go to the ant, thou sluggard;
Consider her ways, and be wise:
Which having no chief,
Overseer, or ruler,
Provideth her bread in the summer,
And gathereth her food in the harvest.'

I am not sure about the harvest, though," he added, a bit doubtfully.

"Father told me about that too," said Ruth. "Some ants do really harvest. They gather the grain they like, and strip off the covering, so that there is sometimes quite a little pile of shucks on the outside of their nest. And some ants are real farmers. They take care of a kind of wild grain—'ant-rice,' some persons call it. They clear away the grass around a small clump of the 'rice' and make little paths to their nests. Then, when the grain is ripe, they carry the good kernels to their burrows and store it away for food."

"I should think it would sprout and grow if they stored it under the ground," said Don.

"Father didn't say anything about that," said Ruth.

"People puzzled over that point for a long time," said mother, "and then a student who watched very carefully discovered just what the ants did. Of course the grain sprouted, and when the ants found this going on, they bit off the little shoots."

"Just as grandfather sprouts the potatoes in the spring!" cried Don. "Aren't they the wise little creatures?"

"Now guess how they keep the grain from rotting under the ground," said mother.

"I am sure they find some way," said Ruth, trying hard to think what this might be.

"They could—dry it," suggested Don, slowly.

"That is exactly what they do!" said mother. "When the grain begins to get too damp they carry it out and spread it in the sunshine until it is quite dry."

"I know!" cried Don. "Just like their eggs. You should have seen them come tumbling up out

of their nest by the tree when I watered the lawn last evening. Every last ant of them was carrying an egg."

"I suspect those were not eggs that you saw," said mother. "The eggs are very small, and what the ants were carrying up were no doubt the larvæ."

"I don't quite understand what larvæ are, mother," said Ruth. "Are they just eggs?"

"Not quite," answered mother. "You remember we spoke of the eggs hatching into larvæ when we were talking of the aphides yesterday. Many insects go through several changes in their lives, and among such insects are the ants. The ant lays eggs. These change into larvæ, which are a kind of legless, and almost helpless, worm. The larva is always hungry; its chief business seems to be to eat all it can get, and it does this with a will. Of course it grows. After it can eat no more, it changes into a cocoon, an oval silk-covered cocoon, from which the ant will come out after a time. It was either the larvæ or these cocoons that Don saw the ants carrying up out of the way of what no doubt seemed to them a very terrible flood."

"Were they nurse ants that were carrying up the cocoons, do you suppose?" asked Don.

"I am sure all the nurse ants were helping," answered mother, "though other ants too may have been assisting in such a catastrophe. But the eggs, the larvæ, and the cocoons are the special care of the nurse ants. They move the eggs from place to place to keep them always at the right warmth. They feed the larvæ, who cannot feed

themselves. Some people think they even coax them to spin their silk cocoons, by gentle strokings and pattings. At any rate, it is known that they watch over the cocoons, and when the little ant is ready to come from the case, the nurses help it, wash it, unfold its wings or legs, and assist it to get started. They take care of it till it is quite strong enough to be a nurse ant itself."

"And does the nurse ant always stay a nurse ant?" asked Ruth.

"No," answered mother. "After a time their skin hardens into a shiny armor, and then they are worker ants. They may go out foraging for food. Perhaps they find a crumb, a bit of honey, or a great treasure like your box of candy. They carry home as big a burden as they can and tell the other workers about their find. Then the procession begins to move, with the results that we found yesterday when we caught them helping themselves to your candy!"

"They go a long way to find food, I think," commented Don. "For a tiny thing like an ant to come all the way to Ruth's candy box is like your going to the city for a loaf of bread."

"Yes," agreed mother, "it is a very long distance for a little creature. But there are ants in western Africa that travel very much greater distances, and in much greater numbers, for food. They are sometimes called the army ants, or the driver ants, and they come in millions and millions!"

"Oh dear!" gasped Ruth. "Whatever do the people do?"

"Sometimes they curl up on beds or chairs, and sometimes they just move out. But rats and cock-

roaches and other things of that sort do not hesitate at all. They move out as soon as they realize the ants are coming. Missionaries and other persons who have seen the ants make an attack say that they come in lines of four or six abreast, going ahead with almost the regularity of an army. Here and there they send scouts out to one side or the other. They find a place to enter the house, and it looks as if they left guards to take care of the entrance. The ants that go into the house run here and there into every spot, and when they leave they have cleaned every single corner of spiders, larvæ, and insects of all sorts. If they encounter one that is too large for a single ant to overcome, others come to help, and not an insect can escape. People report that it is a curious sight to see this great army of ants returning, each laden with booty, along a path which they have worn quite smooth by the tramping of their tiny feet."

"How long do they stay?" queried Ruth.

"Possibly only one night, possibly a little longer in some cases. When they have gone the rightful owner comes back to his house, knowing very well that every nook and crevice will be cleaned of the last trace of vermin that hides in walls or under floors."

Ruth shook her head doubtfully. "That sounds as if those ants were worth a great deal, but I'd rather have Sarah do our house-cleaning," she said.

"Mother," asked Don, "do ants really talk? You have spoken two or three times about their telling one another about supplies."

"Even the wisest men do not know all about the ant," answered mother, "but some very interesting

studies have been made, and it seems quite certain that ants can communicate with one another very readily. No one has ever suggested that they speak, as you and I understand speaking. But look sharply at these little fellows under the glass, and tell me what you see growing out of the head part of the body."

"Two slender things, feelers, I suppose you'd call them," answered Don.

"That name will do very well," smiled mother. "Those feelers are jointed, and are made up of parts called segments. It has been proved pretty thoroughly by experiments that the sense of touch in one of these segments is very keen. In another segment, the sense of smell is very sharp, and it is supposed that an ant who goes a long way from home for food does not see her way home; she does not even feel her way home, but she smells back over the track she made in going out. Now, if you watch these two ants, one going to the nest, with a grain of sugar he has picked up on the floor, and the other coming from the nest, what do you see?"

"Why," cried Don, in great excitement, "what are they doing? Are they fighting? They are both throwing their feelers up and touching each other. Now one is going on and the other—Mother! do you suppose the first one told him about where he found the sugar, and that there is more there? He is going right to the same spot!"

"Perhaps he did," replied mother. "At any rate, your question as to how ants tell each other about their affairs is answered; they talk with their feelers."

"I think ants are the most interesting neighbors!" cried Ruth.

"The most wonderful thing they do is to divide up the work so well, I think," said Don.

"No," said Ruth, with a positive shake of her head. "The most wonderful thing is that every ant does his own share of the work without fussing about it. You need not smile at me, Don Harris," she added with a blush. "I'll weed my share of the garden after this! Who is going to let an ant beat her?"

"Not my daughter, I am sure," said mother. "If you and Don learn a lesson of industry and fair division of work from the ants, don't you think we will have to say they are of some use, after all?"

"Yes indeed, mother," cried Ruth, heartily.

"And if we forget," added Don, "all you need to say is, 'Go to the ant, consider her ways and be wise,' and then we'll remember."

Something to do:

1. Look up in an encyclopædia pictures of ant eggs, larvæ, cocoons, male, female, and worker ants. Make enlarged drawings of each in your notebooks, and place a small mark by the side of each drawing to indicate the actual size. For example, if the actual size is one quarter of an inch, and you make your drawing three quarters of an inch in height, the line one quarter of an inch, by the side of this drawing, will show that you have enlarged it three times.

2. List the helpful parts of the ants' work. Is the ant a good neighbor? Why do you think so?

3. What is the most wonderful or the most interesting lesson you have learned about the ant?

4. What lessons have you learned from the ant?

To learn: Proverbs 6. 6-8.

Go to the ant, thou sluggard;
Consider her ways, and be wise;
Which having no chief,
Overseer, or ruler,
Provideth her bread in the summer,
And gathereth her food in the harvest.

—Proverbs 6. 6-8.

LESSON IV

SPIDER WEAVERS

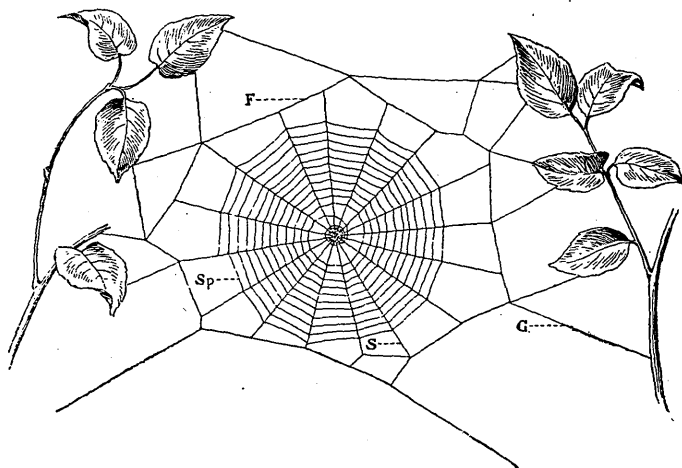
IN our first lesson we made the acquaintance of a back-yard neighbor that we often forget; and we learned how much we owe to these busy but quiet workers, the plowmen earthworms. Next we visited those industrious little creatures, whom we sometimes call a nuisance, and we found that even the ants have their part to play in God's wonderful world.

To-day we are to go to another group of back-yard neighbors who are not quite so numerous as either of the others that we have been thinking of; and perhaps this is a very good thing, as they ply a trade of a very different sort. They are weavers, and are always looking for good places in which to hang their work. If there were as many of them as there are of ants and earthworms, I do not know what would happen!

Each member of this rather large family is the owner and sole operator of one of the most wonderful silk factories in the world. You may find the products of these factories in many places about your back yard. Perhaps a bit hangs from a bush or a vine; another piece of their weaving may be fastened to the rafters of the porch or the garage. You may discover one of the weavers has been in your attic, or in the cellar. Perhaps one has preferred to spread her silken blanket on the grass. You will find it gleaming with dew drops, and you

are almost ready to declare that Titania, the queen of the fairies, has spread her best lace bed-covering out to bleach; for surely these dainty silvery threads were never intended for any but a fairy's use. We shall see!

What, you are shaking your heads, and saying that there are no such factories in your back yard? You are sure you have no neighbors who are silk



GARDEN SPIDER'S WEB

G—Guy lines
F—Foundation lines

S—Spokes or radii
Sp—Spiral lines

weavers? Come with me, and keep your eyes wide open.

Oh, here is a filmy scarf, caught in the ends of the rosebushes! It is a bit of weaving done by the Lady Miranda Spider. You say it is nothing but a cobweb, and that it was made by a horrid spider? It is true that mother calls the spider a nuisance

when it spins its web in the corner of the room, and mother is quite right in sweeping away the spider's work. Lady Miranda need not come into our houses to find a good factory site. But we need not be afraid of her, or of her bite. If we study her ways, we may learn that she is a better creature than we had thought her to be. At any rate, we shall find that she possesses a most remarkable skill.

Look in the corner back of the web; there is the Lady Miranda herself, hiding, and waiting for what may happen. Note how she differs from the ant; the spider is not an insect, for she has eight legs, and these are fastened to the head part of the body. She has no wings. The abdomen is not cut or divided. My naturalist friend tells me the spider's heart has eight lobes, and that most spiders have eight eyes, though you will not be surprised to find that spiders living in caves are blind.



GARDEN SPIDER

But you are eager to see the spider's silk factory. Where do you suppose it is and where do you think the spider finds her material for weaving? From no other place than her own body! She herself is her own silk factory, and within her body she makes the stuff from which she spins her dainty webs. The actual weaving is done by two or three pairs of spinning organs called spinnerets.

It would take a whole book, and perhaps several books, to tell you all the wonders of these spin-

nerets. We would need, too, a very fine microscope to help our eyes in seeing just how they are made and just how they work. If you look up the subject in an encyclopædia, you will find no end of wonderful and interesting facts about them, but you will like to hear now some of the marvelous things people have learned about these silk factories.

Men and women who have studied the spider very carefully tell us that each spinneret looks like a tiny sieve, each having several hundred holes in it. What a fairylike sieve it must be you can guess when I tell you that the head of a common pin will cover hundreds of the holes.

When the spider begins to spin, a gummy stuff comes from the holes. This is fluid when it comes out, but it hardens almost as soon as it gets into the air and the sun. Find out if the spider ever runs her factory on a rainy day, and see if you can tell the reason why.

A spider begins her work by rubbing her legs together until the gummy substance begins to come from the spinnerets. Any or all of the holes may send out a tiny stream, depending upon the sort of silk the spider wishes to make. If you take a bit of silk thread from your mother's work basket, and examine it closely, you will see that it is made up of many fine strands, all twisted together, to make one larger thread. The number of strands that are used will determine the strength and thickness of the finished thread.

The spider follows the same plan. If she wishes to make a fine thread, she will use the substance from a few of the holes. If she wishes a very strong

and heavy line, she will use the material from all of the holes, and she will use it just as the fine strands in the silk thread were used. She will twist them all together to make a strong thread. She may also twist the threads from each spinneret with those coming from the other spinnerets. You can see, then, that the finished thread may be made up of many hundreds of very fine strands. Even then it is finer than one of the hairs of your head. But how strong it is! How far it will stretch before it breaks! You will find it interesting to measure a thread, as it hangs from rafter or bush, and then see to what length you can stretch it before it breaks. Perhaps you can attach a tiny paper to one end, and fill the paper, bit by bit, with sand, till the weight makes the thread break. Then, by getting your druggist friend or your teacher at school to weigh the sand for you, you can find what the strength of the spider's cord is.



HOUSE SPIDER

If you would like to know how a spider begins her web, imprison one by putting her on an upright stick fastened to a float in a dish of water. Can the spider swim away? How will she escape? Watch, and you may see her spin a thread, then she will wait for a soft breeze to blow her, clinging to the end of her silken cable, to some spot to which she can fasten the thread firmly.

If we had seen Madam Spider begin her work,

in our bush, we would have noted that she selected a strong support, probably a branch near the top of the place where her finished web is. Then, in the way just described, she swung a long line to a second support, and fastened it securely. Then she ran back on this line to the middle of the cable, made another fastening, and swung off her second cable. This was done a number of times, till several threads, all coming from a common center, were well secured at the ends to good supports.

Next the spider started from the center and wove around and around a loose spiral, fastening it to each spoke. This made a sort of platform from which she was to weave the web itself.

As soon as the spiral reached the point on the spokes where the edge of the web was to be, Madam Spider began to go back weaving a new kind of thread, not smooth and shining like the first one, but sticky; and these threads were placed much closer together than the first ones. When these were all finished she built herself a secret nest, and stretched from the very center of the web to this nest a strong thread, a sort of a fairy telephone line. No words will ever be spoken over this line, though messages of one kind will travel across it, you may be sure. For Madam Spider, having completed her work, retreats to her secret chamber, and sits there, holding an end of the telephone line in her hand.

To be more exact, the spider hangs from her nest, with one foot on the connecting thread, waiting for a message, which she no doubt is eager to receive. With such a dainty web, and with such a delicate line, you might be excused for supposing

it is a fairy message that is expected. But, of course, you know this is not the case. The web is a cruel trap for an unwary fly or other insect. The instant one brushes his gauzy wing against the sticky threads, the quiver on the telephone line tells the hiding spider just what has happened. She knows exactly what to do. She lets the line loosen. The whole web sags a bit, and the poor insect, trying to escape, is still more tangled in the threads. Then the spider tightens the web once more, and this makes matters yet worse for the fly. I saw this shaking of the web many a time when I was a child, though it was long before I found out the reason for it.

Presently, when the victim is well bound, Madam Spider walks out to inspect her prisoner, though she keeps at a distance till she is certain it is safe to come nearer. Then she may bind her captive still closer; perhaps she will strike her poisoned fangs into the body. When the creature is quite dead, the spider will cut away the binding threads, and then she may suck the juices from the body. If she is not hungry, or if she does not care for the kind of a dinner she has caught, she may leave this hanging in the web till she has tried her luck again.

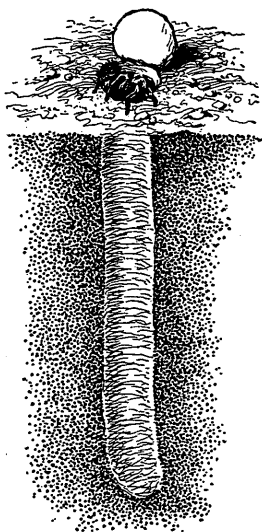
You can see now why the spider must spin such strong threads. If insects could easily break them and so escape, the spider would go hungry many times.

You can find such a web as we have just described, as it is of the commonest sort. There are many shapes and forms, as each kind of spider spins a special kind of web. You can learn to tell

what kind of spider lives in your yard or attic, though you may never see the creature herself, just by knowing the form of web each spins.

Sometimes the webs are very irregular. Sometimes they are dome-shaped. Some are shaped like a funnel. One spider weaves a curious web that looks like the liquid part of a bird's dropping,

while the spider itself resembles the more solid part. An unsuspecting insect passing by this web finds itself suddenly entangled and then stabbed by the fangs of this clever spider!



TRAPDOOR SPIDER'S
BURROW

Note where the spider walks in the web. Why should this be so? Perhaps you will need to put a spider under a magnifying glass to answer this question. You will soon decide that such curious legs are much better for hanging by than for walking. The claws on the feet make it very easy for spiders to hold to the web from the under side. Did you ever

before realize that you have neighbors who hang head downward from their homes, when they are at rest?

If you search along some dry path, or in your garden, you may find the curious home of the trapdoor spider, so named from the sort of home it makes. First it digs out a deep hole in the earth,

carrying away the dirt bit by bit. Next, threads are spun across the opening in all directions. Over these the spider places bits of moss, leaves, and dirt. Then come more threads, and more dirt, till a thick strong door is built. One by one the supporting threads are cut away, till only enough for a hinge remains.

Now Madam Spider is quite ready for business. If she is alarmed, she retreats to her tunnel, holding to the walls with some of her feet, and to the door with others. It is said that the door is so firm, and that the little owner can hold it so tightly shut, that it may be torn apart before it can be opened.

But if she is looking for a meal, she leaves the door open a bit, and is ready to pounce on any unlucky insect that wanders by!

A European student of spiders once tried to find out if spiders think. He found trap door spiders had built their nests in a certain sort of soil, and had used bits of moss to hide the doors, making them look so much like the ground about them that only the sharpest eyes could find the nests. The man took away all the soil around the nest of one spider, and replaced it with earth of quite a different color. Then he broke off the door of the spider's house, and waited to see what she would do. Would she use the earth around her home to build the new door? No, she went off a long distance to get building material such as she had used at the first. Of course this made a door that showed very plainly. If this spider did not think as you and I think she at least was guided by a remarkable instinct.

These are but a few of the plans of the heavenly Father by which these neighbors of ours live. The more you study them, the more interesting facts you will learn about them, and the more you will wonder at the remarkable way in which each little creature has been supplied by God with that kind of body, and with those organs that enable it to fit exactly into that part of his plan in which the Father has placed it. You will come to love and respect all life, in whatever form you may find it, as one way in which God shows us his love and his tender and all-wise care. Over and over again you will think: "This is a piece of God's handiwork. How wonderful it is! How marvelously planned!

'Who can utter the mighty acts of Jehovah?
Or can show forth all his praise?' "

Is it not good to visit our weaver neighbor if she helps us to think of these things?

Something to do:

1. Look for a spider's web, and make a careful drawing of it in your book. Try to learn the name of the spider that made it, and write its name under the web.
2. Watch a spider in her web. Is it true that she always hangs from it, and never walks on it?
3. Write in your notebook the different kinds of webs you have found.
4. Look for an interesting story about Robert Bruce and a spider. What did the spider teach him?
5. A man fleeing from his enemies was once saved by a spider. Who was the man? How did the spider save his life?

6. Decorate a card made from colored cover paper with a picture or drawing of a spider and its web, and write the memory verse on it.

To learn:

James 1. 4a: **Let patience have its perfect work; or**
Ecclesiastes 7. 8b: **The patient in spirit is better than
the proud in spirit.**

**O Jehovah, how manifold are thy works!
In wisdom hast thou made them all:
The earth is full of thy riches.**

—Psalm 104. 24.

LESSON V

SPIDERS AND THEIR NESTS

WE have found that spiders use their skill in weaving, and have their wonderful silk factories, to earn their living, just as do men, though not in the same way. But the spider makes another use of her silk. Can you think what this is?

Of course! The spider, like all others of God's creatures, is obedient to the laws which God has planted in her being. One of these laws, and a very important one it is, is the desire to care for the eggs from which shall develop the young spiders of the next generation. You will be quite satisfied, then, to learn that spiders use their skill in weaving to make strong and often very beautiful cases in which to stow safely the eggs that are to hatch into young spiderlings.

Just as spiders spin webs of many kinds, they spin egg cases of different shapes and designs.

The blind cave spiders make a thin mesh of the threads that only holds the eggs together, without hiding them at all. Some spiders lay all their eggs at one time, and will make a single egg sac to hold them. Other spiders lay a few eggs at a time, and these make a series of egg sacs, and fasten them one to another, something like a string of beads.

If you look in the attic or in the cellar for the egg sac of the common house spider, do not think to find anything lovely in form or arrangement.

Its egg case is a mass of fluffy silk that hides the eggs, but that looks very untidy.

A spider that lives in the grass will hide her eggs under the loose bark of a dead tree. Some spiders add a covering of mud to a little pear-shaped case. Bits of stick or of moss cover other cases. One spider makes a nice felt bedspread from her own body to keep the babies warm.

Another spider weaves in threads of a different kind, lines the inside of the nest in the softest manner possible, makes a wee pocket, and tucks into this a tiny ball of yellow beads—the eggs.

If you find hanging in the web of a garden spider a tiny case that looks like a wee Grecian vase, you may know that it is the egg case, not of the garden spider herself, but of another and smaller spider that often lives in or near the nest of her big neighbor.

Still another egg case is shaped like a lens. One spider lays her eggs in a leaf, and binds the edges of the leaf together. Then she takes no chances of the leaf's blowing away, but fastens it to the branch with her silken threads. Perhaps you may find one of these nests if you look sharply for it.

Certain spiders do not trust their precious eggs to any chance whatever, but carry the sac about with them wherever they go, under the abdomen. One such spider waits till the eggs are nearly ready to hatch out, then she puts them all on the leaves of some convenient branch, wraps the leaves together with her weaving, and stays near at hand to guard the green and silver home. Have you ever found a nest of this sort?

Another spider that carries her egg sac about

with her puts all her babies on her back when they hatch out, and off they go for a ride, like little opossums. When I was a small child I did not know this trick of the spider, and I was greatly surprised one day to see many little spiders tumble from their mother's back and scurry off to the grass when a man stopped the parent as she was crossing a country road.

You would suppose that all spiders, having taken so much pains to weave safe and lovely nests for their eggs, would see to it that the babies had the best of care. But many spiders do not live to bring up their families. They have used up all their silk, and have none left for traps or to bind their prey. Many of them die when the cold days come, and it is old Mother Nature that must care for the babies. Shall we say that? Shall we not rather think that the heavenly Father, who has made all things, has a thought for these little creatures too? It is he who has taught the mother spider to weave so strong a nest that it will hold fast till the warm spring suns crack open the case. Then out come the spiderlings in a great hurry to explore the big world. They know exactly what to do. They climb a stick or a stone, or a dry grass blade, and begin—yes, you are right!—they begin to spin, not a web for the first attempt, but a strong thread. The spring breeze comes along to help by blowing away the thread, and you may be sure the young spider does not let go of it. She hangs on for dear life, and takes her first ride! Thus the circle of spider life has been completed, and a new one started.

Perhaps you are wondering if spiders are of any

use. This is not an easy question to answer, as we do not know enough about spiders to be sure. They no doubt do help to keep down the flies that are so troublesome, though no one has ever studied the question very carefully. The Bible tells us that God saw everything he had made and that it was all good. We have countless things about his plans yet to learn. Some day, a person will study the spider as Darwin studied the earthworm. Perhaps it will be a boy or a girl who reads this book; and there is little doubt that many new and interesting things about spiders will be found.

We have learned, however, that some of the ideas we have long held about spiders are quite incorrect. For one example, many persons fear the bite of the spider as much as they fear the bite of a deadly snake; they believe that both are alike poisonous, and perhaps fatal.

It is quite true that the spider has poisonous fangs, and that its bite may kill a fly. But it is absurd to think that for this reason a spider bite may kill a man or a woman. A flea bite or a mosquito bite may seriously poison a person, especially if that person's health is such that it is impossible to throw off the poison readily. Anyone who is not very strong may be harmed by the bite of a spider, and one ought always to be careful in handling them; but we may lay aside most of our silly fears as to what spiders can do. Usually they will not make an attack if they are let alone, and very probably they pay their way in the world by killing harmful insects.

There are one or two exceptions to the non-poisonous spider that everyone should know. The

first and most common of these is a little black spider, quite easily found in the temperate parts of America. It is known as "the Black Widow." It is coal-black, with a bright red spot on its abdomen. It generally makes its web in outbuildings and under porches and houses where plumbers are apt to come upon it when repairing broken water pipes. There are several well-proven cases of death resulting from its bite. It is said the Indians of the southwest formerly poisoned their arrows by dipping them in the mashed bodies of these spiders. At any rate, it is well to keep a long distance from this very black sheep of the spider family.

The tarantula, a big and ugly-looking spider that does not live in temperate America, but that sometimes comes to us in bunches of bananas from its home in the warmer climates, has been given a very bad name, and is often said to be poisonous. This is not quite proved, but few people would be likely to encounter this fellow. Many persons in the United States say it is not poisonous, but it is much feared, especially in the tropics.

It was thought at one time that the bite of the tarantula was so deadly that it made people ill and they became insane. It was said that the only cure was prolonged dancing, to a strange and weird music which was supposed to drive the poison out. Do you think that the old superstition may have a bit of truth in it, and that the drenching perspiration that must have been caused by long dancing did drive out the poison? At any rate, we have some queer and wild music, which has been in part copied from that to which people danced at such times. These compositions are

called "tarantelles." Ask a good musician to play one for you. As you listen, close your eyes, and imagine strangely dressed people whirling around in a dizzy dance, now one and then another stopping because of being quite tired out, and a new dancer seizing the injured person, and urging, even compelling, him to keep up the effort, until he was too tired to dance another step.

Some travelers tell us that the hairs of tropical spiders make the skin very sore, but this is probably not because they are poisonous, but just because they are hard and stiff. They get into the skin easily, and scratch and irritate it more than if they were soft.

Perhaps you ask why we do not use the strong silk of the spider as we do that of the silk worm. This has been tried, but no very practical way has yet been found of making use of it. The spider does not spin a cocoon in the regular way that the silk worm does, and it is hard to make her spin web silk. One very interesting attempt has been made in France to use a spider that spins an especially strong thread. The day may yet come when boys, going to buy a new necktie, will say: "If you please, show me one of spider silk. I prefer that to worm silk." Or a girl, about to choose a new dress, may hear the salesman say: "This is a fine piece of silk from China; or will you have this spider silk, just received from our factory in France?"

But whether or not we are able to make use of the spider's silk, we may learn a great deal from studying her life and her ways. See how patient and brave she is, and how she tries again and again. She is only a tiny creature following blindly the

way that has been taught her. But she is under God's kind and watchful care, and it helps us to trust and be brave when we think, as we look at her, that

**"Jehovah is good to all;
And his tender mercies are over all his works."**

Something to do:

1. Look in the encyclopædia for pictures of spider egg cases. Copy one or two in your notebook.
2. Find as many spider egg cases as you can and bring them to class.
3. Test a spider's thread to see how far it will stretch, and how heavy a weight it will hold.
4. Write a letter to some friend and tell the most interesting thing you have learned about spiders. Perhaps you can illustrate this letter with drawings of the spider, its web, or its egg case.

**The eyes of all wait for thee;
And thou givest them their food in due season.
—Psalm 145. 15.**

To learn:

**Psalm 147. 5: Great is our Lord, and mighty in power; or
Psalm 148. 5:**

**Let them praise the name of Jehovah;
For he commanded, and they were created.**

LESSON VI

THE HONEY BEE

"Oh, good!" cried Don, as he unfolded his napkin at the tea table one evening. "Honey and hot biscuit for supper!"

"Yes," answered mother. "Grandfather sent us a case of the best white-clover honey from Bonny Brook farm this afternoon."

"Why do you say 'white-clover honey,' mother?" asked Ruth. "Isn't honey just honey, and all alike?"

"Oh, no, indeed!" replied mother. "Honey varies in flavor according to the flowers in which the bees work. Orange-blossom honey has a very distinctive flavor, and is quite unlike white-clover honey. Some people are fond of sage honey, and many will not eat honey made from buckwheat blossoms at all."

"What do you call honey that is made from a mixture of flowers? Tutti-frutti honey?" asked Don.

"There is no such thing as honey made 'from a mixture of flowers,'" replied father. "The bees do not go from one kind of flower to another kind to gather the nectar, even when the opportunity is given, but stick to one sort as long as there is any honey to be had."

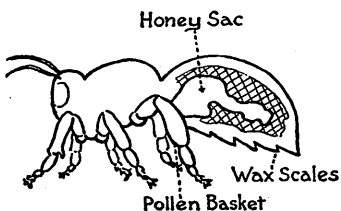
"I should think," said Don, "that someone would find a way of getting honey from flowers by machinery. It would save so much trouble, and there would be no danger of getting stung."

"That is quite an original idea, Don," laughed father, "but one that won't work. The nectar that is found in flowers is not honey. It is changed to honey by the bee."

"I didn't know that," said Ruth. "We used to bite off the ends of the white clover to get what we called the honey, when we were at the farm last summer."

"And it did not taste as this honey does, did it?" asked father.

"No, it did not," agreed Ruth. "But, father, where does the bee turn the nectar into honey? In the hive?"



THE WONDERFUL HONEY FACTORY
(Enlarged)

"No," replied father. "The bee gathers the nectar, and carries it to the hive in a little sac called the 'honey stomach'; here it is mixed and stirred with certain juices that are

in the sac, and by the time the bee reaches the hive, the honey is made."

"I always wished I could see what went on in the hive after bees came in," said Don.

"It is an interesting sight," agreed father, "and some day you must build an observation hive and watch the bees at work. Until that is possible you will have to use your imagination while I tell you what goes on. The bee wastes no time; she deposits the honey in the cells, empties her pollen baskets and then hurries off for another load."

“ ‘Her pollen baskets!’ ” echoed Ruth. “Does the bee have baskets?”

“Yes, indeed,” said father, “two of them, little pouches that grow on her hind legs. She fills these with pollen, the yellow dust that you find on the flowers, and this is made into bee bread for the young bees.”

Comes from market
with Basket on hind leg
full of Pollen

(Enlarged)



POLLEN BASKET

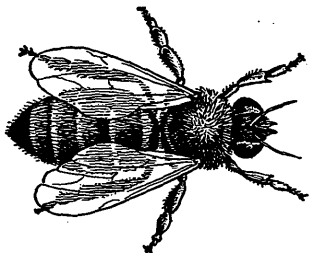
“Are they taken care of by nurses, like the ant children?” asked Don.

“Yes, very much in the same way,” replied father.

“There are three kinds of cells in every beehive. Each kind of cell holds a certain kind of egg, from which a special kind of bee is to develop. The small cells are for worker bees, and there are a great many of these, for the hive will need many workers. Larger cells hold eggs that will develop into drones. In a hive of fifteen thousand bees there might be perhaps five hundred drone cells. Last of all, on the outer edge of the comb are a few large cells, almost acorn-shaped, and these hold the eggs from which the queen bees are to come.”

“And the nurses?” prompted Ruth. “Do they carry the eggs about as the ant nurses do?”

“They do not take the eggs outside,” replied

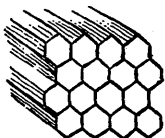


BEE WORKER (Enlarged)

father, "but they are most careful of them. You know that only the queen lays eggs. She is so busy doing this that she has no time to look after the eggs. The nurses follow her about, as she goes from cell to cell. They take great pains to see that each egg is laid in the cell in the right position. They make sure that it is neither too warm nor too cold for the eggs, and when the eggs hatch, how the nurses do work!"

"Oh, I can guess what they do," cried Ruth. "The eggs hatch into hungry little larvæ, do they not, father?"

"Yes," replied father, "astonishingly hungry little larvæ that eat all the nurses will give them for four or five days. Then they get very sleepy,



WORKER CELLS

and the nurses put them to bed in the cells. Each sleepy little grub spins a bed for himself, and goes off into the soundest kind of a nap. The bee workers develop in twenty-one days; a drone or male bee four days longer; and a

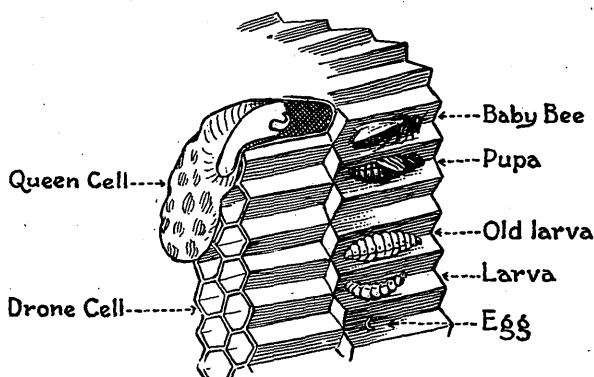
queen from sixteen days to two weeks."

"And are they grown-up bees when they come out, and all ready to make honey?" asked Ruth.

"None of the bees are quite ready to take care of themselves when they first wake up," replied father. "They are weak, and the nurses stroke them and feed them on bee-bread and honey. But it is not long before they get strong and are ready to play their part in the work of the hive."

"Do tell the children the story of the coming of the new queen," said mother. "I think it is the most interesting part."

"I told you," said father, "that the queen larvæ sleep less than the drones or workers, so, of course, they come to a full growth quicker. Their rapid maturity is due to the royal jelly which is fed to them by the workers. Besides this, the royal or queen bee eggs were laid at different times, so the queens are not all ready to leave the cells at the same



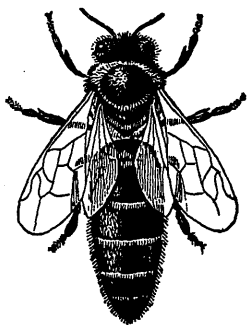
CROSS SECTION OF COMB

time. But when a new queen is ready to come out, she makes a strange little call, that every bee in the hive knows and understands."

"And what does the old queen do?" asked Don. "Is she glad to think her daughter is ready to come out, or is she angry to think another queen is near?"

"She is most terribly angry," replied father. "She would gladly sting the new queen to death if she could but reach her! But the other bees know this, and they guard the new queen, still in her cell, very strongly, and will not let the old one come near her at all. But, of course, some-

thing must be done, and the bees are wise enough to know the best way, generally. If the season has been a good one, and there are a great many bees in the colony, many of them will go with the old queen to find a new home. They set out from the old hive, or, as grandfather says, they 'swarm.' Then the new queen comes out of her cell, and is very lovingly cared for by her subjects in the old hive."



QUEEN (Enlarged)

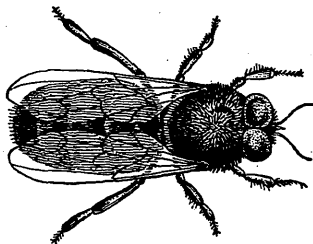
"Is there never more than one queen?" asked Don.

"You are thinking of those other cells, in which royal eggs were laid at different times," smiled father. "Those queens were nearly ready to come out when the new queen emerged. They make in their turn, the same sort of call that she made, and she feels toward them just as her mother felt toward her. She too wishes to get to their cell and kill them every one! But the guards are as careful to keep her from the other queens as they were in keeping the old queen away, at least until they make sure there are not enough bees in the hive for a second new swarm. If there should be, they might take the new queen, and go away to start another new colony. But generally there are too few bees left after the first swarm has gone to make a second swarm. When the bees are sure of this, they leave the royal cells, and it takes the new queen but a short time to decide as to what she shall do! She goes to the cells one after the other, tears them apart, and kills every single young

queen. She will have no dangerous rivals in her kingdom!"

"And then?" asked Ruth, breathlessly.

"Then," smiled father, "having settled for good and all the matter of rule, she goes out to take a flight in the sunshine. You remember we spoke of the drones. They never make any honey; they never do any work. They too have heard the new queen's call as she tried to get out of her cell. They are waiting near the entrance to the hive and when the queen flies into the air, they try to follow



DRONE (Enlarged)

her. She flies high up in the bright sunshine, and only the very strongest of the drones can follow her. The others may come back to the hive for a time, but they are pretty sure to be killed before winter comes. As soon as the queen comes back to the hive she begins to lay eggs, as did her mother when she first came to the hive."

"Grandfather sent away for a new queen when we were at Bonny Brook last summer," said Don. "Why did he do that?"

"Good beekeepers know that it is wise to renew the life of the hive from time to time, and, of course, the way to do this is by getting a new queen," answered father. "Did grandfather put the new queen free into the hive?"

"Oh, no," said Don. "She was shut in a little box of wire, with some other bees that came with

her, and there was a little honey and some bits of candy in the box."

"The new queen and her companions would live on these," said father; "and while the hive bees could not get near enough to her to hurt her, they could come to the outside of her cage, sip the honey, and get acquainted with her. Grandfather knows bees so well, he could tell, by listening and watching, when the bees were ready to take her for their queen. Then he would open the hive, take out the old queen and let the new one come out of her cage."

"But, father," said Ruth, "I want to know what becomes of the bees that 'swarm.'"

"We were so interested in seeing what the new queen did that we nearly forgot the old one," said father. "Probably the new swarm would not go far. Very likely they would settle on a low branch of some tree near at hand, piling one on top of another in a great mass, with the queen snugly hidden in the middle. A good beekeeper like grandfather is generally ready for this leaving of the old hive, and has a new one at hand to offer the bees. He may spread a blanket or sheet on the ground under the hanging swarm, set the hive on it, and brush the bees to the blanket. A little honey on the inside of the hive tempts the bees to go in, and if the beekeeper is sure the queen has entered the hive his work is nearly done. He need only move the hive, after dark, to its place among the other hives. The bees 'clean house,' making everything really as 'neat as wax,' and then they settle down to their real business in life, and begin to make honey as if nothing had changed at all."

"A bee is such a tiny thing, I do not see how they make so much honey," said Ruth. "Grandfather had pounds and pounds of it."

"You forget how very industrious bees are, daughter," said father. "A good colony will often make as much as one hundred pounds in a summer, just by keeping always at it."

"It depends, does it not," asked mother, "on when the bees swarm? I have heard grandfather say

'A swarm of bees in May
Is worth a load of hay.' "

"Yes," replied father, "and there is another rime that shows how much less later swarms may be expected to yield:

'A swarm of bees in June is worth a silver spoon;
But a swarm of bees in July is not worth a fly.'

That is not always true, for July swarms may make good buckwheat honey."

"The ant may be a wise back-yard neighbor, but I think I like the bee better," said Ruth.

"I like what she gives us, at any rate," laughed Don.

"Both ant and bee have a place in God's wonderful plan for his world," said father, "though from our point of view the bee may seem more useful to man. Honey has always been highly thought of as a food, and the land promised to the people of Israel was thought to be of special worth since it was a 'land flowing with honey.' Indeed, people in Bible times valued honey so highly that they often compared the teachings of the Lord to it."

"Oh, I remember!" cried Don. "'The ordinances of Jehovah are true. Sweeter also than honey and the droppings of the honey comb.'" Psa. 19. 9, 10.

"And 'sweeter than honey to my mouth,'" added Ruth.

Father nodded his approval. "There are many other fine verses in the Bible about bees or about their product. You will find them in books like the Psalms, Proverbs, and in Matthew. Look up some of them, and learn the ones you like best."

"The ants taught us to divide our work," said Ruth, as they rose from the table. "I wonder what the bee will teach us?"

"Why, to keep busy, of course!" cried Don. "Don't you think the tea dishes call for you this minute?"

"Oh, I hate dis— No, I *don't!*" cried Ruth. "Mother, you rest in the swing, and I'll be 'as busy as a bee' for twenty minutes; then you'll never know there were any tea dishes!"

Something to do:

1. Catch a bee; wet it slightly. Dust with flour or talcum powder very lightly, handling the insect gently. Place the bee on the windowpane and watch it clean itself.

2. Feed a bee a bit of honey; let it fly to the window. Look for the distended honey sac. It is about the size of a small sweet pea, and at the large end of the abdomen.

3. In a nature book or an encyclopædia, find a description of the wings of a worker bee. What is the reason for this wing plan?

4. How does a bee hear and smell?

5. Make a little book of Bible verses about bees and honey.

6. People in Bible times were fond of riddles. Samson made a riddle about a swarm of bees. You will find it in Judges 14.

What was the riddle, and what was the answer?

To learn: Psalm 119. 103; *or* Psalm 19. 7-10.

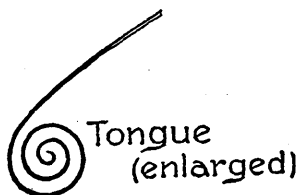
Not slothful in business; fervent in spirit; serving the Lord.—Romans 12. 11.

LESSON VII

BUTTERFLIES AND MOTHS

No neighbor that comes to our garden wears more beautiful clothes, eats, in most cases, more delicate food, or seemingly leads a more carefree life than do the butterflies and moths.

How we love to see them flitting about from flower to flower, sipping the nectar from lily or honeysuckle, skimming across the lawn, or waving their gorgeous wings in the warm sunshine.



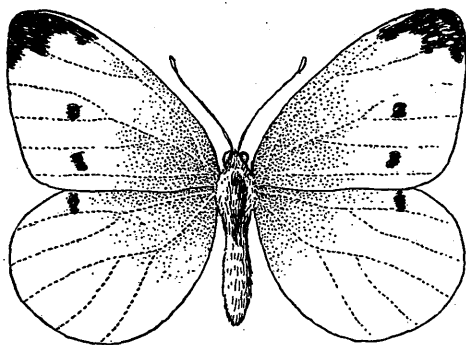
Surely, you say, such lovely creatures must have an unusually lovely home. But did you ever find, or, for that matter, did you ever even hear of, a butterfly's nest? Ants' nests, bees' nests, wasps' nests, but no butterflies' nests! One reason is that the life of a butterfly, as a butterfly, is short. For the brief time of its life any shelter that it may chance upon will serve its needs. So you will find the butterfly is so made that the building of a shelter would be difficult, if not impossible, for, as a rule, no creatures are given parts that they do not, or will not, need to use.

To find the whole life history of the butterfly, we must go in search of a creature quite different from the butterfly. Perhaps the easiest way to

trace this very interesting history will be to obtain some butterfly eggs, and see what happens!

Now, of course, you cannot go out among the flowers and find butterfly eggs as easily as you might expect to find hen eggs on the farm! The butterfly eggs are so tiny that you might easily overlook them, and they are laid in all sorts of queer places. Perhaps the whole mass of eggs may be no bigger than the head of a pin, though each tiny egg would show a delicate and pretty form.

But even though these eggs are so dainty and delicate, and so very small, they are not laid in a nest, as are the eggs of birds. They are very carefully placed in what you might consider the queerest spots for a future home—on such things



Cabbage Butterfly

as cabbage leaves, or elm tree leaves, or in fruit trees. They may be placed on beans or grain. Some butterflies may select palm trees. Certain kinds of moths look for woolen carpets, mother's furs, or your best Sunday suit as the proper place for their eggs! Each one follows the instinct that God has put in her little being, and selects that place that this instinct tells her will be the best food for

her babies. One very strange thing is that quite often the butterfly or moth may come to the kind of a place for egg-laying in which she has passed no part of her life. One butterfly, for example, spends most of her life among oak leaves; she may even eat decaying flesh; but she will look for a willow on which to lay her eggs.

If, then, you are to go hunting for butterfly eggs, you must know likely places in which to look for them. If you choose a time rather late in the season, you are almost sure to get butterfly eggs by catching the butterfly herself, and shutting her gently in a glass jar or covered box, with, perhaps, a few leaves of the food plant. After the butterfly has recovered from her fright, she will very likely lay a number of eggs on the leaves; and then you can permit her to fly away again.

You will be wise to keep the box in which the eggs have been laid well covered over the top with a piece of close netting or fine gauze, for butterfly eggs are very well liked by many tiny creatures who will eat them up, if you do not prevent it!

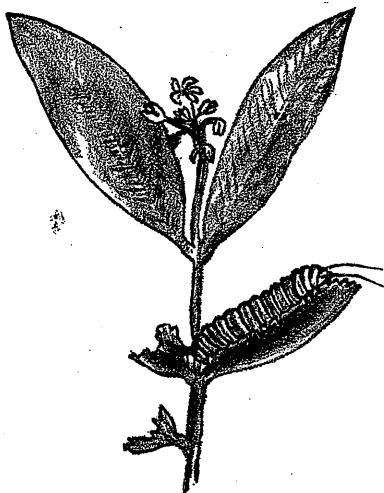
Watch your jar for a few days, and before very long you will discover that the wee eggs have hatched, not into lovely butterflies, but into crawling caterpillars. Now you must feed them, and you will probably be quite surprised at the great amount the wrigglers can eat. If you were watching at just the time the caterpillar came out of the shell, you might have seen it turn around and eat the shell the first thing. But this does not satisfy it for very long. It wishes its own green food and plenty of it. Perhaps you will need to put a narrow strip of sticky fly paper around the

top of the box in which you are keeping the caterpillars, or they may crawl out in search of more food.

Presently you will note that the caterpillars have grown too large for their clothes, just as you grow too large for yours. But the caterpillar does not need to buy a new suit when his old one splits up the back, for a new one has been growing underneath the old one! After getting out of the old suit, the caterpillar will rest for a few hours, while he is getting used to his new dress, and then he begins to feed again. Some people say

that the first thing he eats is the old suit! I think it will be a good thing for you to discover if this is ever true, true in some cases, or always true.

After the caterpillar has changed suits several times, perhaps four in all, a very strange thing begins to happen. The caterpillar begins to spin some silken threads, which it fastens very securely to some surface. Next it proceeds to twist and tangle its hind legs in these threads. Then it hangs head downward, and the skin along its back begins to split. When the skin is nearly off, the queer



MILKWEED CATERPILLAR

little body that is left often gives a quick jerk to catch certain little hooks at one end of it into the silk threads which the caterpillar wove. After a



Butterfly Caterpillar

short time the outside skin hardens into a case, the shape changing a little before this really happens, and the little case that is left hanging to your box, or to a dead branch or the side of the house, is called a chrysalis.

You may often find chrysalides hanging to branches, to walls, tucked away in crevices, or rolled up in leaves. Some are nearly covered with bits of sticks, dust, fibers of plants, or the scale bodies on which the larvæ live. All of these different coverings serve to hide and so protect the chrysalis. If you bring them into the house in the fall, and place them in a cage made of wire netting, you can keep them safely till it is time for the next change to take place, and then you will have the chance to watch one of the most wonderful events in nature.

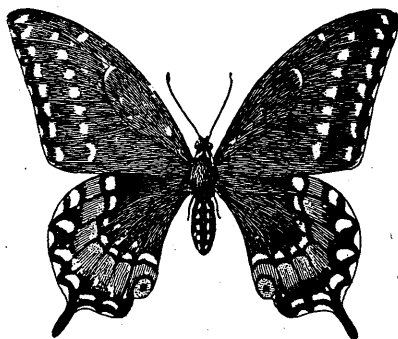
For, as you have guessed by this time, the creature that comes out of the chrysalis is not a caterpillar but a lovely-winged butterfly or moth, as the case may be.



Chrysalis

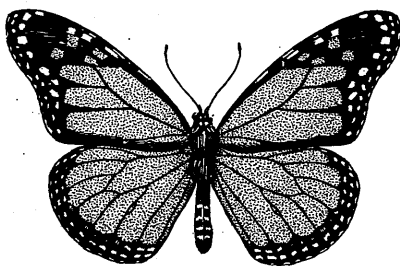
In most cases, the chrysalis breaks at the front end, where the head will come out. It looks sometimes as if the little creature on the inside wets the case with a fluid from its mouth, which no doubt softens and

dissolves the shell. Then the butterfly-that-is-to-be crawls up on the skin, or shell, which is still held by its support. The wings are bigger than they were when in the shell, but they are still wet and crumpled, and the abdomen is large and clumsy. But as the wings are stretched out, and slowly moved, they dry. They fill with the body juices. They lengthen. They grow strong. Usually the front



THE SWALLOWTAIL

wings do not get to their full size as soon as do the hind pair. The abdomen grows smaller and becomes slender. After an hour or two spent in the sunshine while the tissues of body and wing grow firm and strong, the butterfly is fully grown, and flies away to make the best of its little life, to enjoy the sunshine and the flowers, and then to lay the eggs that shall in good time bring other butterflies into being.

THE MILKWEED BUTTERFLY
THE MONARCH

It is hard to tell just how long a butterfly or a moth lives. But it is supposed that some varieties pass the winter in the winged or *imago* stage. Other

varieties pass the time of cold as caterpillars, or in the *larva* stage. Many live through the fall and winter as *chrysalides*. You may be surprised to know that some kinds live all through the cold days as butterflies, and that the eggs are not laid till spring. Some varieties have a complete life cycle from egg to *imago*, or complete butterfly or moth, at least twice in each summer, while others complete five life cycles in a year.

We often speak of butterflies and moths as if they ate nothing but the nectar from flowers, but this is not always the case. Some of them are very evidently fond of kitchen refuse. The beautiful purple emperor has been discovered eating decaying flesh.

While moths and butterflies have many things in common, there is a real difference between them, and it is usually not hard to tell one from the other. Butterflies as a rule fly only by day, while moths come out at night, though a true night-flier may sometimes be seen flying on a dull or cloudy day. Moths spread their wings when at rest; butterflies usually fold theirs, holding them erect. Moths generally have a stouter body than the butterflies, and their feelers are feathery, while the feelers of the butterfly are slender, and end at the tip in a little clublike swelling.

An interesting story of moth and butterfly is found in the way they protect themselves through coloring. Many moths rest with the hind wings concealed beneath the front ones. In such moths the front wings are often very dull, and may be spotted till they so closely resemble the surface on which the moth usually rests that you might put

your hand on one before you saw it. Yet the under wings may be very brilliant and lovely in color and markings. Butterflies that fold the wings together may show only a dull surface on the under part of the wing, while the upper part will be vividly marked.

One very curious butterfly looks exactly like a leaf when it is at rest. Its tail comes down so as to touch the branch of the bush and looks like the stem of a leaf. A little notch where the wings start lets the head withdraw till it cannot be seen. The markings on the wings look exactly like the ribs of a leaf, and no matter how sharp your eyes are, you are almost sure to be fooled by the clever mimicry.

It is thought that some butterflies are known to the birds through their brilliant markings to be bitter and unpleasant to the taste, and that, for this reason, the birds let them alone. Other butterflies do not have these same bitter juices, but are let alone because they look like the others.

One other protective trick that you may have noticed in some butterflies is their zigzag flight, which makes them more difficult to catch. No doubt the very spiny, woolly coat which some caterpillars wear must make them disagreeable to many birds.

There are other ways of which we cannot tell here in which butterflies and moths and their caterpillars escape their enemies. See how many of them you can discover for yourselves. You will find it a very interesting chapter written by the hand of God, and as you learn of the wonderful plans he has made for the care of his little creatures which we often overlook or forget, you will come to have a new love for his goodness. You will find

out many new facts, but no matter how much you may study, you will always say, "Thou knowest not the work of God who doeth all."

Of one truth you will come to more and more sure—"the earth is full of the loving-kindness of Jehovah." The butterflies and moths will help you to understand this, and you are sure to feel that, in doing so, they have played the part of very good neighbors indeed.

Something to do:

1. Find and read Robert Graves' poem on the caterpillar.
2. Make an Easter card from heavy paper; decorate it with butterflies, which you may copy from a colored plate, or paste on from crepe paper. Write on the card the verse you will find in Job 14. 14.
3. Watch for butterflies during the day. Write descriptions of their markings. Note what flowers and trees they visit. Try to secure butterfly eggs as described in the text.
4. Look for cocoons and egg cases under rafters, along fences, in the woods.
5. Go to a bright street lamp, or place a bright light in a window, and study the moth visitors. How many kinds can you name?
6. Write a short story of the life of a butterfly.
7. Write in your notebook one fine lesson the butterfly teaches us.

To read:

1. "The Example," a lovely little poem by W. H. Davies on a butterfly; *or*
2. "A Caterpillar's Apology for Eating a Favorite Gladiolus," a poem by Charles Dalmon.

He hath made everything beautiful in its time.—Ecclesiastes 3. 11.

PART II

FEATHERED FRIENDS

LESSON VIII

HUNTING BIRDS WITH EYES AND CAMERA

"I AM going on a bird hunt to-morrow," cried Doctor Cookman, overtaking Don and Ruth on the way home from school one Friday afternoon. "Don't you want to come along?"

"Indeed I do!" cried Don, eagerly.

Ruth hesitated, searching anxiously the merry, laughing face of her favorite teacher. Then, as her eyes fell on the camera he carried over his shoulder, her face brightened.

"Do you really mean we may go with you on a camera hunt for birds?" she asked, as eager now as Don.

"That is just what I mean," replied Doctor Cookman. "The birds are at their nest-making now, and we ought to get some great pictures!"

"Oh, what fun!" exulted Ruth. "Indeed I do want to go!"

Next morning, after a very early breakfast, the trio set off for a long day in the country.

"First we will explore this sand bank above the brook," said Doctor Cookman. "I hope to get a picture of the nesting holes of the bank swallows. Yes, here are several."

"Those nice, round holes?" asked Don. "They look as if they had been cut out by one of grandfather's drills."

"They do indeed!" laughed Doctor Cookman.

"But they were tunneled out by a bird smaller than the English sparrow."

"How far back in the bank do they run?" asked Ruth.

"I opened a tunnel once, in October, after I knew that the birds had gone, and that tunnel was more than two feet in length. Quite a bit of work for a pair of tiny birds like the two flying over yonder," and the professor pointed across the little stream.

"I did not know birds are tunnel-borers," said Ruth.

"Very expert borers, some of them," replied Doctor Cookman. "The kingfisher builds a deeper tunnel, but we do not see him as often as the swallow, because he always selects the bank of a stream in which fish live. Both the kingfisher and the swallow use their tunnels for homes as well as for nests."

"Does the kingfisher really fish?" queried Don.

"Yes, indeed!" replied Doctor Cookman. "The plumage is very oily, and well adapted for sudden plunges into the water. The bird will sit high up on some branch over the stream, and when a good dinner swims below it drops like a flash and comes out of the water a minute later with a squirming fish held tight in the beak. This may be eaten at once, or it may be carried to the hungry nestlings in the tunnel. When you get home, look up Neltje Blanchan's amusing description of these bank babies and the way they get their meals."

"Where next?" asked Don, as Doctor Cookman folded his camera after snapping a picture of the swallows' holes.

"We will try for a view of that tall elm in the

meadow yonder," replied Doctor Cookman. "An oriole has just finished her nest, and I am quite sure that this is just the right light for a good photo. See if you can discover the nest, Ruth."

Ruth turned bright eyes on the drooping branches of the elm, and looked searchingly at it.

"I do not see a nest, but there is a queer-looking bag hanging from that low branch," she said.

"That bag is the nest," laughed Doctor Cookman. "It is one of the cleverest nests in all bird-dom. It is hung where boys and snakes and squirrels cannot reach it. It is rain proof. It is so strong that it will hold a family of four or six till the young have grown big enough to fly away. It is deep enough to hide the members from any robber hawk. It is made of—no, I think I won't tell you what it is made of. Take my field glass, Ruth, and see how many things, different materials, you can discover on the outside of the nest. Then when Don and I have finished with the photograph, I will tell you what I have found on the inside of orioles' nests."

"Hair, string, a strip of rag, a bit of yarn, dry grass," announced Ruth, a few minutes later when Doctor Cookman and Don threw themselves on the grass beside her.

"Quite right!" approved Doctor Cookman. "One seldom finds all of these materials in one nest, but our Madam Oriole has been visiting the back yard of Mrs. Brown, and has taken a rag from the ground perhaps."

"And the inside of the nest?" asked Ruth.

"It is probably lined with milkweed and plant fiber," replied Doctor Cookman. "Perhaps she has

also used bits of bark. This nest is partly covered over the top, because, as I suspect, Madam Oriole knows the hawks have a nest on yonder cliff, and she means to make herself and her nestlings as safe as possible."

"How many nestlings will she have?" asked Don.

"A Baltimore oriole's family is from four to six," answered Doctor Cookman.

"Why do you call them 'Baltimore' orioles? Is it because they come from Baltimore?" asked Ruth.

"Oh, no!" laughed Doctor Cookman. "Orange and black, the oriole's colors, were the colors of Lord Baltimore, who settled Maryland. There is a tradition that he chose those colors because he admired the orioles so much. I suspect he had chosen his colors long before he came to Maryland, and that the bird was named because it wore his colors, but you may take your choice of the two reasons."

"I choose to think that Lord Baltimore chose his colors from the bird," responded Ruth, very promptly.

"James Russell Lowell loved the oriole," went on Doctor Cookman. "You ought to learn his lines that begin,

'Hush, 'tis he!

My oriole, my glance of summer fire.' "

"Teacher, *teacher*, TEACHER, TEACHER!" called a voice from the thicket across the road, so earnestly that Don and Ruth both sprang to their feet.

"An oven-bird!" exclaimed Doctor Cookman. "Let us see if we can find the nest. It would be fine to have a picture of one. But you must expect

to spend a long time looking, as it is the very hardest of all nests to see."

The three crept softly into the dry woodland, and began to search among the leaves.

"The nest will look like a tiny mound, a wee Dutch oven," whispered Doctor Cookman. "You may even think that some plant is just beginning to push up the leaves. Watch for the parent birds. If we come upon them feeding among the leaves, they may show us where the nest is."

Presently Ruth's small finger pointed. "There are two birds looking for worms," she said.

Doctor Cookman nodded, and they all crept on softly. A crackling twig startled the birds, and they began to show much alarm. The mother limped, dragged her wing as if it were broken, and did all she could to distract the attention of her unwelcome visitors.

"The nest cannot be far," said Doctor Cookman. "I do not wish to trouble the birds, but the nest is a sight worth seeing. We will not touch it, and they will become quiet as soon as we go. Begin here as the center, and we will work out till we find it."

"Here it is!" cried Don, after a few minutes of careful search.

"See how much it looks like the ground around it," said Doctor Cookman. "We are very lucky to have found it at all. Here is the opening on one side, and—look, there are five speckled little eggs in it!"

"If they only knew we would not think of touching one of their precious eggs!" said Ruth, with an eye on the anxious parents.

"We will be off in a minute," said Doctor Cookman, busy with his camera. "There, I am sure that will make a splendid picture. Now I would like to show you another nest I found recently over in that clump of willows."

Ruth and Don followed their friend to the side of the brook, and there, firmly built in the fork of a small willow, was an odd-looking nest made of plant fibers, leaves, and grass. Ruth stood on tiptoe, and caught her breath as she saw the dainty lining of hair, feathers and down.

When the three had found a sunny place on the bank, Don turned to Doctor Cookman.

"Why is the nest so tall?" he asked. "It looks like a—like a—well, almost like a three-story nest on the outside!"

"That is exactly what it is!" said Doctor Cookman. "But the two lower stories are never to be used. Most of the bird books tell of such nests, but we do not often find one. This nest was built by a yellow warbler, and she has built one nest on the top of another, till she has three of them!"

"But why?" asked Don.

"I have often told you that Citizen Bird is one of our best friends and helpers, and that is generally true. There is one exception to this rule. This is the cowbird. Look yonder across the fence and you will see a cowbird walking about among the cows."

"She is a busy bird; what is she doing? Eating the bugs and insects that the cows disturb?" asked Ruth.

"Yes, that is probably why she likes the company of the herd," said Doctor Cookman, "and as far as that goes, she is a good neighbor. But the cow-

bird is lazy, and will not build a nest for herself—she prefers to steal one!”

“Oh,” cried Ruth, “does she drive the other birds away?”

“No, indeed!” said Doctor Cookman. “She is quite too lazy to care for her own babies. So she lays her eggs in the nest of some smaller bird, like the yellow warbler, or the vireo, and goes off. Our yellow warbler here in the willow found the cowbird’s big egg in her nest, and could not roll it out, so she built a second nest on the top of it, though it sealed one of her own eggs. But this was better than having a great cowbird baby to feed and to take from her own children the best of the food. But even after the second nest was finished, the cowbird, on the watch for her chance, laid a second egg, and Madam Warbler built the third nest.”

“The brave, clever little mother!” cried Don.

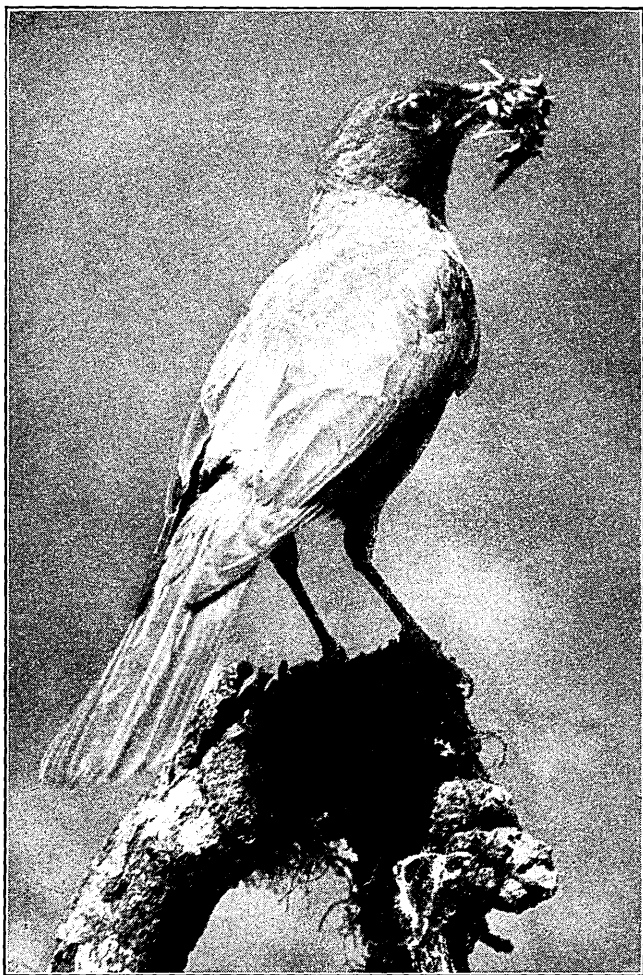
“The cowbird is ever so much like the dodder, isn’t she?” asked Ruth.

“I think she is,” smiled Doctor Cookman. “It makes little difference whether it is a plant or a bird or a person, we do not admire one that does not make his way by fair means.”

“No, indeed!” agreed Ruth and Don heartily, as they turned toward home. As they went along the meadow path Ruth’s sharp eyes fell on a broken blue shell.

“Oh, Doctor Cookman,” she cried, “what happened to this bird’s egg?”

Doctor Cookman searched for a minute, then pointed out a softened mass of mud and sticks lying on the ground.



(Photograph by William L. and Irene Finley. By permission of *Nature Magazine*, December, 1924)

ROBIN

"It is the wreck of a robin's nest," he said. "Robins use mud instead of clay to plaster their houses. Of course the nests tumble after such a hard rain as we had the other day. The phœbes, the barn and the cliff swallows are wiser. They build under bridges, cliffs, or the eaves of the barn, and so are safe."

"There are dozens of swallows under the eaves of grandfather's barn at Bonny Brook," said Don. "The farmers say that you can tell when it is going to rain by the way the swallows fly. Is that true, Doctor Cookman?"

"There may be a bit of truth in the saying," said Doctor Cookman, "but it is not that the swallows know any more about the rain than you or I do. The swallow hunts for insects when flying through the air. You can see that insects with their fine gauzy wings cannot fly high when the air is heavy with moisture; so that the low flight of the birds may indicate possible rain."

"The swallows must be glad for dry nests then," added Ruth. "I should think all birds would make nests under the eaves or in hollow trees."

"Many birds do nest in hollow trees," said Doctor Cookman. "Other birds, not finding the right sort of hollow, will make one. The woodpeckers are best at this. Their bills were made for hammering, drilling, and chiseling. After they desert their homes bluebirds, chickadees, owls, or wrens may move in."

"Birds have as many different kinds of homes as do people!" cried Ruth.

"That is quite true," agreed her friend. "You have seen only a few of the bird homes to-day, but

the more you know of them, the more interesting you will find them. You will discover that each bird has its own part to play in God's great wonder world. To each little feathered neighbor God has given exactly the tools that best fit it to do its own work. One may have a hammering bill like the woodpecker. Another may have a long and slender tongue like the humming bird. One bird will have stiff hairs around its bill to help in catching its insect dinner. One bird's best tool will be a pair of long legs for wading. When you find a bird with a tail or a coloring or a bill or tongue that is ever so little different from another bird's, you may ask the meaning of this difference. You must always be sure it has not happened just by chance; there is a meaning back of it."

"How many things there are to know!" sighed Don.

"That is true," laughed Doctor Cookman. "It is because there are so many things to know that life is so interesting. And the very best part of the knowing is that we come to understand our heavenly Father better. Job says:

'Ask now the beasts, and they shall teach thee;
And the birds of the heavens and they shall tell thee.'

"Some of our very best lessons of trust and faith come from the birds."

"'God feedeth them,' " murmured Ruth.

Doctor Cookman smiled down on his little friend.

"Yes," he said, "'They sow not, neither reap;' they have no 'store-chambers nor barn; and God

feedeth them.' If God cares so much for a little bird, do you not think he will care even more for you? And if the birds have such a great part to play in fulfilling God's plan, what do you think of the part that boys and girls may play? Don't you agree that it must be worth the best that one can put into it?"

"Yes, indeed!" agreed Don as he took up the camera and started toward home.

Something to do:

1. Send to the National Association of Audubon Societies, 1974 Broadway, New York City, for Educational Leaflets, with illustrations and outlines of birds. The cost will be small, and you will have much pleasure in learning all about the birds of your own vicinity.

2. Paste on a cardboard a large colored picture of a bird which you may perhaps find in a catalogue or magazine. Arrange at one side, one above the other, the letters that spell the name of the bird. Cut the picture into strips. Make several of the cut-ups, and put them all in a box. Such "Sliced Birds" will be a good rainy day game, and will help you become familiar with the birds.

3. Play a bird game with your friends. All the players but one, who is IT sit in a circle. IT, standing in the center, points to a player, saying, "Bird, one, two, three, four, five!" The player pointed at must name a bird not previously named by a player during the game, before IT says "Five," or take the place of IT. The game may be varied by saying "Bug" or "Beast" instead of "Bird," at the will of IT.

To learn: 1. Matthew 6. 26; or Isaiah 65. 14a; or Matthew 10. 29-31.

2. "The Sandpiper," or some other short poem about birds.

3. Learn to identify as many birds as possible in your neighborhood.

**He giveth to the beast his food,
And to the young ravens which cry.**

—Psalms 147. 9.

LESSON IX

BIRD GUARDIANS

No, I do not mean the eagles, though they are our national bird, and are stamped on our coins. I am thinking of far less imposing and lordly feathered creatures than eagles. I have in mind the woodpeckers and the nuthatches, the warblers, the vireos and the meadow larks, the gulls and the owls.

"Owls!" do I hear you exclaim in horror: "owls are not guardians. We need to guard against owls: they steal poultry." Not so fast, not so fast, my child! There is much to be said for the owl, as you shall find out presently.

Of course you have always admired the birds for their pretty ways and their delightful songs. You have watched for their coming in the spring, and have been sorry to see them fly south when the cold autumn winds began to blow. Did you ever stop to think how useful the birds are? You know how the earthworm serves us. You love the honey that the bee gives. You think that even the ant and the spider may have a part to play in making and keeping our world in order. But what do the birds do?

"Four and twenty blackbirds baked into a pie;
When the pie was opened, the birds began to sing,
Isn't that a pretty dish to set before the king?"

That is what many have said about birds—fit only

to kill and eat. It took a great many years for people to learn how stupid and foolish this is, but we are coming now to know that birds are as useful creatures as live on the earth. We could not get on without our plowmen earthworms, to be sure; nor could the earthworms get on without the birds. If now and then a hungry robin makes an early breakfast from a worm, he has helped the earthworms by making possible the green food the worms need.

There are so many harmful insects that live on cultivated plants, the leaves of trees, in the crevices of the bark or under it, even in the fruit of trees, that it is said they would in ten years, if unchecked, eat every green thing off the earth! But our good guardians keep always busy at their work of watching these destructive insects. Bugs and beetles, their eggs and larvæ, worms of more kinds than can be mentioned here, all are sought out and destroyed by the sharp-eyed and busy little birds. If it were otherwise, you and I would go very hungry indeed.

Someone has figured out that every meadow lark eats enough grasshoppers in every season to make that lark worth a dollar to the farmer. The farmer who kills enough of these songsters to make a single pie has had a pretty expensive dinner, has he not? Insects make up almost three quarters of the lark's food; the rest is largely weed seeds. Do you not agree that the man who allows a lark to be shot on his farm could as wisely make a bonfire of his money? He would be no poorer in pocket, and the world be happier, since the song of the lark would still remain!

Birds need far more food in proportion to their size than does man. Their hearts beat faster, and their blood is so much warmer that in humans it would indicate a high fever. All of this demands much food to keep the tiny life going, and so birds are kept very busy searching for something to eat. It is hard to guess how much is actually eaten, though persons who have tried to bring up by hand young birds that have been injured or that have fallen out of the nest, have more than once been quite astonished at the amount of food that a nestling demands in a day. Many birds eat their own weight of food in twenty-four hours. If you were to eat as much in proportion to your size, it would mean that you would require forty, fifty, or sixty pounds of food per day.

Stop, then, to think how tiny are many of the eggs, the bugs, or the worms that the birds eat, and guess, if you can, how many of the troublesome creatures our guardians make way with in a single day. In a season all of the birds probably eat many tons of such food—food, that, if allowed to live and grow, would spoil our crops, our fruit, our trees. Do you not think we can afford to let the robins, for example, have a few of our cherries and strawberries, or permit the mocking bird to eat a few grapes in payment for the really splendid service they give us?

Among the helpful little guardians that you may watch at their work are the warblers. There are many members—cousins, if you wish—in this large family. They seem to like insect eggs extremely well, and begin with them. When the fresh-egg season is over, and the larvæ have come from the

eggs, the warblers turn attention to them. After a time all the larvæ turn into insects, and then the birds begin on the insect itself.

But another point will interest you. All of the warbler family do not work on the same part of the tree. There seems to be a very sensible and convenient division of work among them. God has given some of them slender little bodies, and special tools for doing special kinds of work. Certain of them will care for the tree trunks and the larger branches, looking into each tiny crack for eggs that may be hidden away. Others hunt through the twigs and the foliage, peeping under each leaf and looking over each stem. They know where the clever insects are likely to hide their eggs! Still others work largely on the ground, searching under dead leaves and catching many an insect that would harm the lower part of the tree. All of them are very fine aviators: they can take nose dives, and make sudden and unexpected swoops from limb, telephone wire, or tree branch, to catch fly or insect that is floating by, looking, it may be, for a safe place to hide some more eggs.

There is many an interesting story to be read in the lives of some of the insects on which the birds live, and none is more fascinating than that which has to do with the way the insects try to defend themselves against the birds. Whole books have been written about this one side of insect life alone, and you will find many pages about it in your library. One way that some insects have taken is to grow a hairy coat, and to look very fierce. Suppose you were a bit of a warbler, and were to encounter in a tree a huge tent caterpillar? Do you

not think it would look to you like a monster? That hairy coat that so many of the caterpillars wear must seem most unpleasant to the smaller birds, and many of them will not touch these roughly-clad customers. But larger birds, like the slim cuckoo, are not so particular about a few hairs. These birds can easily get in and out among the thick branches of the trees, and they make short work of the caterpillars. They eat them, hairs and all. Do you not agree that we can forgive the cuckoo for the disagreeable and lazy trick of foisting her egg and the bringing up of her children on some other mother, when she proves herself such a useful member of the world society?

Orioles too eat caterpillars, beetles, cut-worms, and a long list of other harmful life. Their food list is nearly as long as is our own, though I am sure you will think it not at all like ours. But without them we would be in a very sad fix. A worm-infested tree in a California yard was visited morning after morning, for several days, by a Bullock's oriole. The owners watched the bird's attack on the worms from a screened porch, hardly daring to whisper, lest the little helper be frightened away. When the tree was quite cleaned, the oriole returned no more. His police duties no doubt took him to other quarters.

The purple martin is a member of the swallow family and may be coaxed to settle in almost any yard, if a suitable house which cats cannot enter is provided. Martins like swinging nests, such as may be easily made from dried gourds. They are social little things, and will live happily in bird apartment houses that provide for several families.

Peach growers often hang such nests near their orchards, or erect tall poles to hold a house, and feel that they are a hundredfold repaid by the destruction of tree pests on the part of the martins.

The chipping sparrows, the grosbeak, wrens, nut-hatches, and chickadees, all are helpful little guardians. Hundreds of harmful insects are destroyed by them, and much of their vegetable food is made up of weed seeds. The wren may be coaxed to become your near neighbor by providing her a box for a home, the entrance to which is so small the English sparrow cannot pass. This fighting little fellow disputes the right of possession with the wren whenever there is a chance of an outcome favorable to the sparrow, and Jenny Wren is no match for such a foe!

A beautiful bird that looks after our shade trees is the downy woodpecker. He wears a tiny red cap, and a black coat striped with white. His tail is wedge-shaped, and helps him to keep his place on the bark of a tree, as he goes round and round the trunk, looking in every tiny crack for insect or grub. Let him once hear the faintest sound of creeping creature in a bit of dead wood below the bark, and he uses his strong bill as both hammer and chisel, to dig out the intruder, and make way with him. This good citizen is one of our best helpers. Indeed, he is so valuable in preserving the forests that Enos R. Mills has given him a whole chapter, and he names him "Dr. Woodpecker, Tree Surgeon." He tells of the way the woodpecker uses his barbed tongue to pull out a borer when he has drilled his careful hole, and writes such a fascinating account of his tree work that

you will all wish to read it for yourself. Certainly, you will always feel a thrill of gratitude hereafter whenever you hear the drumming of the woodpecker on a dry tree branch, for you will take it as a sign that he is about his very important business of preserving the trees from their enemies, or drilling holes to fill with nuts for winter.

One bird that has been not a little misunderstood and charged with being a robber is the owl. Owls undoubtedly have been sometimes guilty of robbing the farmer of chickens. I once saw a very large owl caught in a trap set for him in the front of the chicken yard; he had been taking several chickens every night until the angry farmer resolved to stop his thieving. But such deeds are rather rare. A news item in a California paper not long ago told of two school boys who found a nest belonging to two owls. There were six eggs in the nest, all of which hatched. The boys kept careful count of the food brought to the baby owls, and learned that in the first seven weeks of their lives the young owls ate three hundred and seventeen gophers and ten mice. The parents almost surely ate twice as many rodents as they fed to their babies. Do you wonder that these boys refused one hundred dollars for the two birds?

Another bird lover banded a pair of owls ten years ago, and thus he knows that they come back year after year to nest in the same college tower. In one year he found on the floor of the tower room nearly a thousand skulls of rodents that had been eaten by the owls. If each year the owls raised five young, which was the average for the nest in the ten years, and each birdling ate ten mice a

night, during the seven weeks they remained in the nest, do you not think they were doing their share in keeping these pests under control? Suppose all these young birds lived, made their own nests, and raised their own young, feeding them at the same rate, how many hundreds of rats, mice, gophers, and squirrels have been eaten by this family and their children in the ten years? You must remember too that all of the animals named as food of owls are harmful and destructive. They destroy food and material in vast amounts every year, and probably do much to spread disease, so the owls are helping greatly when they catch and kill them.

It would take far too long to tell you of all the ways in which birds of different kinds act as guardians. It can only be suggested that many birds, such as gulls and buzzards, serve as scavengers, and help by keeping our shores and inland stretches clean by removing dead and decaying fish and flesh. Other birds keep down the destructive weeds, and it is estimated that even the noisy and disagreeable English sparrow kills enough noxious weeds every year to pay his way. You should study the birds of your own community, find out what they eat and how they live, and what you can do to make them more useful. Perhaps the best way for you to serve is by making houses for them. Perhaps you can more easily help by planting the wild fruit that they like; this may keep them from feeding on your cultivated fruit, and at the same time persuade them to stay and fight your insect enemies. In this way you will be paying a part of your debt to your guardians,

and you will be helping your Father in caring for his creatures. For you remember that Jesus said: "Behold the birds of the heaven, that they sow not, neither do they reap, nor gather into barns; and your heavenly Father feedeth them." You will like to think, too, of the lesson of trust Jesus taught, when he looked at the men in the streets selling sparrows to the poor people: "Are not two sparrows sold for a penny? and not one of them shall fall on the ground without your Father. Fear not, therefore: ye are of more value than many sparrows" (Matt. 10. 29, 31).

There are many lessons of trust, of cheerfulness, of making the best of things, of happy industry, that the birds have for us if we will look for them, and when we once realize how much of our welfare and happiness depends on their careful guardianship of our trees and crops, our American sense of fair play will make us wish to repay our feathered neighbors by caring for them in the best ways we can find.

If you would like to know what would happen if all our birds were killed or banished, find Henry W. Longfellow's poem, "The Birds of Killingworth," and you will get a picture of a place without a bird. Would you like to live in such a place? How many ways can you find of making sure that your town will never be in the unhappy situation in which Killingworth found itself?

Something to do:

1. Make a list of the birds that you have seen in your community. Which ones stay all the year? Which ones do you see only in the summer? Which ones come only in winter?

2. Make a list of the birds that are mentioned in the Bible. Find a fine Bible description of some bird.

3. Find and read the story of Saint Francis of Assisi and the birds.

4. Learn and recite a beautiful bird poem.

To learn:

Matthew 6. 26: **Behold the birds of the heaven, that they sow not, neither do they reap, nor gather into barns; and your heavenly Father feedeth them. Are not ye of much more value than they? *or***

Matthew 10. 31: **Fear not therefore: ye are of more value than many sparrows.**

He sendeth forth springs into the valleys;

They run among the mountains;

They give drink to every beast of the field. . . .

By them the birds of the heavens have their habitation;

They sing among the branches.

—Psalm 104. 10, 11, 12.

LESSON X

LANDLORD TO THE BIRDS

MEN who own houses for rent are always eager to find good tenants to occupy them, tenants who will prove pleasant neighbors and who will make a community to which other tenants will like to come. I am sure you will feel that no neighbors could be found who would be more desirable than the birds of which we talked in the last lesson, and I suspect you will find that playing landlord to them will bring you a great amount of pleasure and interest. How shall you go about it?

The answer depends upon the season of the year in which you are starting out to be a landlord. Let us suppose that it is early winter. You think this is a very unfavorable time to start? Not at all! The number and the kind of birds that stay with you all winter will depend not a little on the part of the country in which you live, but in almost any section you will find a surprisingly large group that stay the entire year. Take a bird census and learn the names of those that belong in your community, and then you will know how to begin your work.

You may need some help in this census-taking. Let us suppose that you live in the vicinity of New York City, or not far from the forty-second degree of latitude. Then you will find Neltje Blanchan's seasonal list of birds, as given in *Bird Neighbors*,

will be of use. Take the list and see how many of the birds named you can discover for yourself.

You will find several good bird books in your library; one has been written for the Eastern part of the United States, and one for the Western. If you live in the country, you will go to the woods and the thickets to look for the birds described in these pages. You will perhaps search along quiet roadsides, where weeds still stand with seed cases not yet emptied, or you will walk through an old cornfield, if some of the shocks have been left standing. Your snow-blanketed vegetable garden may be another good place to find the birds at breakfast.

If you are a city dweller, you need not be discouraged. Many a city boy or girl has had as many bird friends as any lad or lass that lived in the open spaces. City parks, as well as country woods, offer a resting place to birds, and you will be surprised to see how many feathered visitors you can coax to your city windows when you send out the right sort of invitations.

What invitations should you use? In winter, first of all, food! Think how hard it must be for birds to find food when snow covers the ground, and ice coats the weeds so that every little seed is well hidden. If you provide good cafeterias for the birds, you will quickly find how eagerly they will come to enjoy them.

Sometimes the very best way possible is to place a broad shelf outside the window. This you will keep free from snow, and every morning you will spread crumbs, bird seed, bits of meat, suet and nuts on the shelf. If you are careful not to

frighten the birds at first, it will not be long before you can watch them as they eat, and you will learn many interesting things about these brave little winter friends.

It is a good plan, when you can do so, to make a sliding shelter, putting it on a wire and letting it slide from your house into the branches of a tree. It is easy to fasten a rope to one side of the box, so that it can be pulled back every day to be re-filled. Such a shelter can be made very easily by any boy or girl. Use a starch box for it, cutting the ends into points to form a gable. Make a roof that projects a little, as this will prove a better protection from snow and wind. Cut the sides away to allow the birds free entrance, and to make the shelter light enough for comfort. A small wire basket may be fastened at each end to hold suet and meat scraps.

If an evergreen tree with thick, sheltering foliage grows near your home, strips of suet may be tied to this for the birds. Strong shallow baskets firmly tied or securely nailed to tree trunks will make a good bird dining room also. Perhaps you have a porch roof easily reached from a second-story window, which you can keep free of snow and well spread with the dainties that birds like best.

You may prefer to make a feeding shelter to be placed on the top of a pole, and provided with broad sides that will serve as weather vanes. If this shelter is pivoted so that it will swing as the wind blows, feeding birds will always be protected from the cold winds as they eat.

Neltje Blanchan, in *How to Attract the Birds*, gives directions for making up a bird food, which

can be prepared and cooked in quantities, then packed away for use as needed. You will like to try this.

But your fun as a landlord to the birds has only begun when you cater to them in the winter. You will find that bathing tubs bring them quite as surely as well-filled dining tables, for birds are very clean and dainty little creatures, and love a safe, cool bath. In setting up bird baths you must remember two or three points. The first concerns cats! Cats love birds as food, and we must not blame them too much; they are but following the laws of their nature when they stalk and kill birds. One way to prevent the killing of birds by cats is to banish the cats. Another way, less sure, is to see that Pussy is well fed, so that birds do not offer too great a temptation. A third way is to place baths, shelters, and houses on poles or in trees, too far above the ground for a cat to spring to them; then you should also place around the tree a guard which cats, snakes, and red squirrels cannot pass. A broad strip of tin, which can be made from old cans opened by melting the solder over a hot fire, will be useful if nothing better can be had. The very best guard is one of wire, the lower part of it extending outward like a many-ribbed open umbrella. Such a guard is very useful and looks well on a tree.

As to the form of your bath for birds, that may be left to your own choice. Only let it be shallow, as a deep bath offers too many dangers to the small birds. They may easily drown. If the bath is broad enough to permit, you may add stones on which the birds may perch. In any case you should

place the bath where it will be partly sheltered, and where birds have not far to fly for a safe perch while they preen and dress their feathers.

If you can arrange a bath so that water will continually flow into and out of it, this will be most satisfactory. If this is not possible, you can change the water every day, and perhaps in the hottest part of the season it will need to be replaced twice a day. But how your feathered tenants will enjoy it, and how well they will repay you with songs and antics and pretty ways! Do not miss this part of the fun of being a landlord.

An equally important part of your duties as landlord is the providing of proper homes for birds. Now, birds of many a feather will peaceably share a common bath, and a bath of almost any sort, provided it will hold water. But not so when it comes to selecting a home for the season, a home in which the precious eggs are to be laid, and the more precious babies are to be brought up. Here is a point at which you will need to use your very best judgment as a landlord!

In spite of the fact that the English sparrow is a useful bird as an insect destroyer, he does make a nuisance of himself in other ways sometimes, and it is well to have this in mind when building bird houses. It is said, for example, that bluebirds like a house that swings from a wire better than one that is fixed. The sparrow does not like this kind of house, so if you suspend your house you are more likely to attract bluebirds than sparrows. Try it and see if this is true.

Again, the sparrow does not hesitate to drive Jenny Wren from any shelter that he fancies, pro-

vided he can get in to take possession. But Jenny can enter a hole through which the larger sparrow cannot squeeze himself. When you are making a house for the wren, be sure that you make the opening just big enough to be comfortable for her, and the fighting little sparrow will be forced to leave her alone.

It is also said that many birds are very particular about the height of their homes, and that sometimes they will pass by an attractive house again and again when fixed at one height, only to take possession of it eagerly when it is raised or lowered. Books tell you to put martin houses at heights varying all the way from eight feet to forty feet! I think you will just have to try till you find out the height best suited to the birds of your own section. John Burroughs, who studied our birds so carefully, said that most of our song birds build low, half of them making nests less than five feet from the ground, and three-quarters of them in nests less than ten feet from the ground. Find out if this is true of the birds in your section. List the birds that build below the five-foot line; list those that build above the ten-foot line. Ask yourself why birds choose their nest sites as they do. Long, long ago a singer thought about this very question, and he put his thoughts into a lovely song. You may read it in Psalm 84. What do you think his answer means?

From what are you to make your houses? From almost anything that is at hand. Tin cans may be turned into a house that will suit many a bird tenant. They may be laid on the side, the opening being covered by a board through which an

entrance has been cut. The can may stand on end, with a semicircular piece cut on the side, and bent down to form an alighting place. Holes ought to be punched in the back of the house to permit ventilation. Tin can houses ought also to be covered with bark or wood, both to make them cooler by protecting them from the sun's rays, and to hide their glitter, which birds do not like. Many clever houses may be made from them, however, and it will be good fun to spend the long winter evenings in devising ways to use them, and then you will have your supply of dwellings ready in plenty of time for the first tenants who arrive from the South.

Gourds provided with stout cord or raffia hangers, and baskets woven from reed and raffia, or willow and raffia, are other possibilities. I once saw a cunning nest made of five bits of board and a ball of twine: this was a clever idea that the maker learned from a tiny bird that built her nest in a twine ball he had left tucked in the supports of an arbor.

Other bird landlords have used the bark-covered slabs that can be found at saw mills, and which boys can quickly turn into usable houses with a little work. Robins are said to prefer open houses, with little more than a roof, particularly when it is well hidden among the shrubbery. Other birds like better to live in holes hollowed in trees; these birds would be attracted to houses made from small logs sawed into halves, hollowed out, and then nailed or screwed together again.

After a season or two of experimenting and designing, you will find yourself well equipped to

play the part of a successful landlord to the birds;
and it is safe to say that nothing you do will give



(Photograph by H. L. Bohlman. By permission of *Nature Magazine*, May, 1924)

THE JOY OF MAKING BIRD HOUSES

you more pure joy. Your care for these little beings
so wonderfully made by God will be rewarded a

hundred times; and you will have the delight of knowing that you have added much to the pleasantness and beauty of his world.

Something to do:

1. Read Longfellow's "The Birds of Killingworth." Make a little play of the poem, and invite your friends to see you give it.

2. Get all of your friends, both boys and girls, to make bird houses from original or copied designs. Have the birdhouses put on exhibition at a certain day. Ask some older people, perhaps the mayor of your village and your minister, to serve as a committee to decide which is the best, the most original, and the most useful of these houses. A red, a blue, and a white ribbon, may mark the first choices.

3. Arrange for a Bird Day, when throughout your community your bird houses will be put in place for the use of the birds.

4. Make a collection of colored prints of birds. Mount these pictures nicely on cardboard, leaving a good margin at the bottom. As you see each bird in your own vicinity, place the date and the locality under the picture.

5. Try to find some person who will imitate for you the songs and cries of your local birds. A very interesting entertainment can be given by such a person. If you charge a small sum for admission, you may be able to interest people and also to secure money to build a bird fountain.

6. Perhaps you will like, yourself, to learn to imitate bird calls.

To learn:

Luke 9. 58: . . . **The birds of the heaven have nests.**

Matthew 10. 42: **Whosoever shall give to drink unto one of these little ones a cup of cold water only, in the**

name of a disciple, verily I say unto you he shall in no wise lose his reward; *or*

Isaiah 11. 9: They shall not hurt nor destroy in all my holy mountain; for the earth shall be full of the knowledge of Jehovah, as the waters cover the sea.

PART III
GARDEN LIFE



LESSON XI

HOW PLANTS GROW

And God said, Let the earth put forth grass, herbs yielding seed, *and* fruit-trees bearing fruit after their kind, wherein is the seed thereof, upon the earth: and it was so. And the earth brought forth grass, herbs yielding seed after their kind, and trees bearing fruit, wherein is the seed thereof, after their kind: and God saw that it was good.—Genesis 1. 11, 12.

DON and his small friend Hugh were at work weeding a bit of new lawn, when Hugh, who had been resting a minute and gazing at the row of cannas that stood against the house, said, "What big leaves those cannas do have! Leaves are just the most important part of a plant, aren't they, Don?"

"No, sir, not at all!" replied Don. "The roots are the most important part; look at this one I have just pulled; it is several inches long."

"Silly!" laughed Ruth; "you are both wrong. The flower is the most important part, of course. Doesn't mother always water and trim her plants so they will have just the best flowers she can get from them?"

"Let's ask mother," cried Don. "This weeding is nearly done, and it's too hot to work longer in the sun, anyway."

So the three went to the shady porch, where mother was busy with some sewing, and asked to

be told which is really the most important part of the plant.

"To answer that, we will need to see what parts the plant has, and just what each does for the plant," said mother. "Suppose you pull up two or three plants by the roots, wash them free of soil, and bring them to me. Don, you may bring several weeds. Hugh, pull a little bean plant, a lettuce, and a tomato plant from the garden, and Ruth, you may find a young radish and a little beet plant."

In five minutes the children were back with the plants, and Don brought the magnifying glass from the library.

"Suppose you look at the roots first, and tell me what they are like," suggested mother.

"They are just like thick threads, and there are ever so many hairs growing from them," said Hugh, as he looked sharply at his bean plant. "What are the hairs for, and what is a root good for anyway?"

"I have found out one thing roots are for," answered Don, promptly. "It is to hold the plant firmly in the ground. Didn't I have to tug to get some of these weeds out?"

"Indeed you did," smiled mother, "and that is one very good use that roots have. Can you think of another?"

"Don't the plants eat through their roots?" asked Ruth.

"Yes," answered mother. "That is how they get food. The little hairs suck in the water and other material that makes the plant grow. If you look through the glass, you can see a tiny cap on

each root, like a very wee thimble. This is to protect the end from hard substances that would wear or hurt the root, as it pushes its way through the soil in search for food for the plant."

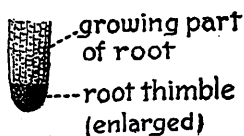
"The hairs are so tiny I should think it would be hard for much food to get through them," said Don.

"One of the most interesting things about the plant is the way it prepares its food," replied mother. "You do not eat sugar, but you put it in your cocoa, where it dissolves. In very much the same way the solid earth food is dissolved in a sort of acid that is in each tiny root-let. This makes it possible for the roots to suck in the food; you might say the roots make a soup for the plant to drink."

"Plant soup—how funny!" chuckled Hugh. But Don said, checking off on his fingers:

"Two uses of roots; to

The Buttercup



hold the plant and to feed the plant. Any more, mother?"

"Certainly," said mother, very promptly. "At least some roots have another use. What vegetable did you have for lunch, Don?"

"Creamed carrots and beet salad," answered Don at once.

"And what part of the plant did you eat?" asked mother.

"Why, I never thought, but I suppose it must be the root," replied Don.

"But it's not a bit like my bean plant root," objected Hugh.

"No," said mother, "you are right. The bean roots and others like them are called fibrous roots, since they look so much like fibers or threads. Fat roots like those of the beet, the carrot, or the radish, which Ruth has here, are called fleshy roots. They are really storehouses for the plant. You know plants like the radish, the beet, and the carrot do not spend much energy in making fine blossoms or fine fruit. They lay by the extra food that might be used in this way in their roots, and that is just why we choose to use them on our tables—there is so much good food stored up in their big fleshy roots."

"Then the roots are the most important parts, aren't they, mother?" demanded Don.

"Stems are important too," said Ruth, before mother could answer.

"Humph! stems!" cried Hugh. "Why, some plants don't have any stems at all. My narcissus plants haven't any; they just sit on the ground."

"We won't decide yet which is the most im-

portant part of the plant," said mother. "But let us think of Hugh's narcissus plant for a minute. It is true that some plants have no stems, and we name them *sessile*, from a Latin word that means exactly what Hugh said—'sitting.' But the wise men tell us that the narcissus does have a stem, though it is not strange that Hugh should think it has none. What did you put in the ground to get your narcissus flowers, Hugh?"

"It was a little round fat brown thing, something like an onion," answered Hugh.

"That is what we call a bulb," said mother. "If you had wished, you could have stripped off layer after layer of what are really brown underground leaves. Your bulb is an underground stem, from which the leaves and the roots grow. Plants of this sort store their food in these thick underground stems, and the real roots are the tiny fibers that grow from them."

"Then I suppose that, if plants store food in their stems, we sometimes eat stems," suggested Ruth.

Mother's eyes twinkled. "Indeed we do," she said. "We had stems for dinner yesterday, and will have others for dinner to-day."

"I know!" cried Don. "Asparagus!"

"Celery too," added Hugh.

Mother nodded. "Something else, besides those two very good stems," she said.

"Surely not—potatoes," suggested Ruth, hesitatingly.

"And why not?" asked mother. "It may be a queer-looking stem, but if you will look closely at a potato you will see little buds starting from the 'eyes' or marks on the potato. The little scales

are really leaves. So the potato cannot be a true root for only root hairs and root branches grow on the roots."

"Do we eat any other stems?" asked Hugh.

"Suppose you think about it and tell me tomorrow," said mother. "Try to find other uses that the stem has too, for you must remember that plants do not grow just to feed hungry boys and girls."

"I was sure stems are important, but I think leaves must be most important of all," said Ruth, decidedly. "Aren't they, mother?"

Mother held up a warning finger. "Do not decide too quickly. Remember the true scientist gets all the facts first and then comes to a conclusion. Let us see what work the leaves have to do for a plant."

"Work!" cried Hugh. "Do plants have to work?"

"Certainly!" said mother, "especially if they would grow and be healthy, and have a nice family of children. We spoke a little while ago about the broth the roots dissolve out of the earth for the plants. This is a kind of raw food. How would you like it if you never had any but raw food to eat?"

"Oh, that would be dreadful!" cried Don and Hugh in a breath.

"Plants do not like raw food any better than you do," said mother, "so one part of their work is to cook food, or at any rate to prepare the broth for the use of the plant. Where do you suppose this is done? Where is the fire for the cooking?"

"The sun?" suggested Ruth, doubtfully.

"How can the sun reach down to the roots, and cook the broth?" objected Hugh.

"I know, I know," cried Don. "The sun does the cooking, but the kitchen is the leaves, and not the roots!"

"Quite right!" agreed mother.

"But how does the broth run up hill to the leaves?" questioned Ruth.

"That is hard to understand," said mother, "and the very wisest men are not altogether sure about it themselves. But you know it does run up. You have broken off a milkweed, or a poinsettia, or some other leaf that grows on a plant with milky juice, and you have seen how the plant 'bleeds.' And you can understand that when the juice runs all through the leaves that are spread out in the sun it will be 'cooked' in the heat. But the leaves are more than kitchens for the plant; it is through them that the plant breathes and perspires."

"Oh, mother, does a plant really breathe?" asked Ruth with much interest.

"Do you remember those dusty weeds that grew along that sandy stretch of road just beyond grandfather's barn? How did they look?" asked mother.

"Why, as if they were sick and almost ready to die," answered Ruth.

"That was just because the dust had covered them so thickly they could not breathe well; they were choked so that the air could not pass in through the little openings or mouths that you can see on every leaf if you look at it through a microscope. Do you not remember how the aphides choked up the rose leaves till they died and dropped?"

"And you said plants perspire too," suggested Don.

"You can prove that for yourselves," answered mother. "Take a leaf and press it against the window pane. You will see the water collect on the glass just as it does when you breathe on the glass. When a plant gives off water faster than it takes it in, what do you think happens?"

"Why, I should think it must wilt!" cried Hugh.

"That is just what happens," agreed mother. "Some plants perspire much more than others. A single big sunflower plant may give off as much as a quart of water in a day. It is thought that a lawn that contains an acre of ground gives off several tons of water in twenty-four hours. The reason a leaf fades and wilts when it is broken from the plant is that the water keeps on going out through the little mouths, and there is no way of replacing it after the connection with the plant has been broken."

"Does grandfather cover his young plants in the garden to keep them from losing water too fast?" asked Don, recalling the way the young cabbages had been looked after the summer before.

"Just for that very reason," answered mother. "Some plants—these same cabbages—can help themselves to keep the water from oozing out when they are grown stronger. Did you ever notice the waxy covering on the cabbage leaves or on the rubberplant? Other plants grow a covering of fine hairs. Some plants that grow in places where the sun is very hot will hang their leaves so the sun cannot strike much of the surface in the hottest part of the day. Still others have leaves that are very small, or they may have fewer mouths through which the water can pass."

"Leaves are certainly the most—no, very—important, parts of the plant, aren't they, mother?" asked Ruth.

"They most certainly are," agreed mother, smiling, "and the next time we will talk about a special kind of leaf that very, very many plants have. These leaves have a most important work to do, and I think you will wish to find out all you can about it. Perhaps you can discover just what we call these leaves before next time."

"Root, stem, leaf," said Don, thoughtfully fingering the plant in his hand. "Each part has its own work to do, hasn't it, mother? A plant is a sort of vegetable city, just as ants are an insect city, only it is stuck fast in one place and can't move about."

"Yes," agreed mother, "each part of the plant has its own place to fill. Each fits into a part of God's plan, and helps in his work. Plants, as well as animals, are created by his hand. Do you remember the verses you had last week at our morning hour about God's care of the plant world?"

"Oh, yes," cried Don.

"Thou crownest the year with thy goodness;
And thy paths drop fatness.

.

The valleys also are covered over with grain;
They shout for joy, they also sing.'"

"And my verse was, 'He maketh grass to grow upon the mountains,' " said Hugh.

"Mine is the best of all," said Ruth. "It is

'Thou openest thine hand,
And satisfiest the desire of every living thing.'"

"I like to think of the plants as neighbors," said Don, "and I mean to know ever so much more about them before I stop!"

Something to do:

1. Dig up and study some simple plant, noting its parts.

2. Draw or trace in your notebook a simple plant. Mark the parts—root, stem, leaf.

3. Look in a textbook of botany, and learn the names of different kinds of stems. Make a list of as many as you can find, and give an example of each.

4. Find out for yourself if leaves of plants do perspire.

5. Place a few seeds, like those of radish or grass, on blotting paper or cotton in the bottom of a dish. Pour a little water in the dish. Cover with a glass and keep in a warm place. Do not permit the seeds to get dry. Watch their growth, and make drawing of them in your book.

6. Make a list of a dozen plants that are of most use to man.

7. Make a list of the plants that are most useful to animals other than man.

To learn: Psalm 65. 9-13; or Genesis 1. 11, 12.

LESSON XII

A PLANT AND ITS FLOWER

Consider the lilies, how they grow: they toil not, neither do they spin; yet I say unto you, Even Solomon in all his glory was not arrayed like one of these.—Luke 12. 27.

"I've thought and thought, and I can't find any special leaves or any special work they do," said Ruth, as the three children gathered on the porch for the next talk about plants.

"I think I know, mother," said Don, eagerly. "I asked my teacher, and she says you must mean the *flower*. She says many people say that the little green things just below some blossoms—*bracts*, she called them—and the green leaves around the flower cup, and even the colored flower leaves, are just changed real leaves. And she says, too, that those little threads in the very middle of the flower are changed leaves, and that some of them show ridges just like the middle rib of the leaf," and Don sank back in his chair and took a long breath after this lengthy speech.

Mother smiled at the eager and questioning faces of the three.

"That is a very fair statement of fact," she said, "and I am glad you took the pains to get it all so clear in your mind. Not all flowers show the change clearly, but you can study it for yourself in the peony. Some time, when you have a water lily, see if you can tell just where the white petals stop

and the yellow 'threads,' as Don calls them, begin. Some petals are almost 'threads' and some 'threads' are almost petals."

"The threads have a special name, but I do not remember it," said Don, apologetically.

"Yes," said mother, "there is a special name for these parts, and we will learn it soon. It is not hard, and we may as well learn to call things properly. But before we try to get the name, look carefully at a flower, and tell just what you see. This cherry blossom will do splendidly for study, for all its parts are so easy to see."

"Let me start," begged Hugh, and at mother's nod, he bent over the flower. "First, on the outside is a little green cup, cut into parts."

"That," said mother, "is called the *calyx*, and the separate parts or leaves into which it is cut are called *sepals*. What do you suppose the calyx is good for? Look at these buds that have not opened and you may find one reason."

"I should think it would help keep the little flower leaves inside safe and warm," suggested Hugh.

"Good!" replied mother; "I am glad you are thinking. Now, Ruth, what next?"

"There is a cup of white leaves," replied Ruth.

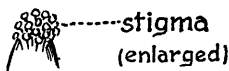
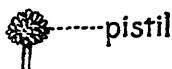
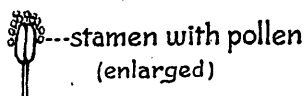
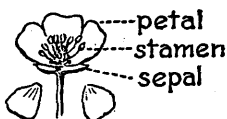
"This cup," said mother, "is called the *corolla*, which means 'crown,' and each separate part or leaf is a *petal*."

"Oh, those are easy words!" cried Ruth. "Calyx, sepals, corolla, petals. I like knowing the right names, mother!"

"Now, Don, tell us what is next," smiled mother.

"A number of little threads with bundles of yellow powder on the ends," replied Don.

"These little threads are called *stamens*, from a word that means 'standing,'" said mother. "The powder has its own name too. It is called *pollen*. It is made up of many tiny grains, each one beautifully shaped and marked. Some day you may have the opportunity to look at them under a powerful microscope, but our small glass will not help you very much, so I have brought these pictures to show you just how the pollen grains from some of our common flowers look;" and mother opened a big book by her side, and pointed to pictures of pollen grains greatly enlarged.



"Oh," cried Hugh, "there is one just the shape of my foot ball!"

"That one looks like the sea urchins we found on shore," said Don.

"And that one might be a snail from its shape," said Ruth, pointing to a third.

"Are they all marked like these?" asked Don.

"Usually, though in many different patterns," replied mother. "Each flower has its own shape; each kind of pollen has its own marking. Tiny as they are, each is perfect, and very beautiful. But

the most wonderful fact about them is that each has hidden away in it a tiny speck of living substance. The wisest person that lives cannot tell you all about this substance, but we do know that it is a part of every living thing."

While mother was speaking Hugh had been gazing intently at his cherry blossom, and now he said:

"There is one stamen in the middle of my flower that has no pollen. Did it shake off, or didn't any ever grow on it?"

"Good for you, Sharp Eyes!" cried mother. "No, that particular thread is not a stamen, and it never had any pollen. Look again and see if it is just the same shape as the stamens. Do you find one in your blossoms too, Don and Ruth?"

"Yes," said Ruth, "and it is shaped like a little club. What is it, mother?"

"Its club shape makes people think of the pestle with which druggists make their powders, and so it was named the *pistil*," answered mother.

"The end of it looks moist and sticky," said Don, who had been peering through the magnifying glass.

"That is true in most cases," said mother, "and you will soon see why it needs to be so. Tell me how the bottom part of the pistil looks."

"It is much thicker at the bottom," said Don.

"I shall cut through this part," said mother, "so that you can see just what is on the inside," and with a small sharp knife she cut to the very bottom of the pistil.

"It is full of little baby seeds," cried Ruth.

"That is exactly what you see inside the pistil box," agreed mother. "Each little seed has its own

speck of life substance, though it is not the same sort of substance as is found in the pollen grains. But no little seed will ever become a real seed, a seed from which a new plant can come, without some help from outside of itself. Where do you suppose this help may be found?"

"Maybe the life substance of the pollen would help, but how could it ever get down into this firm little case?" asked Don, thoughtfully.

"It is the life substance of the pollen that helps," agreed mother, "and I will tell you how it reaches the baby seeds. You remember the moist sticky top of the pistil? A pollen grain falls on this, and what do you suppose happens?"

"It might swell and grow, just like a seed in the ground," said Don.

"Something very like that does happen," answered mother. "When the inside has grown large, the outside case of the grain cracks open along one of the markings, and a tiny tube that makes you think of a rootlet begins to push its way down through the pistil. This wee tube carries its speck of life substance to mingle with the life substance of the baby seed. Then the seed begins to grow. The flower leaves will begin to fall off, and the stamens will lose all their yellow pollen. But the pistil will stay. Do you know what it becomes?"

"You said it would grow into a seed," began Don, slowly, then, as he thought hard for a moment, he suddenly added, "It must grow into the cherry pit, of course!"

"Of course!" agreed mother. "From these 'pits,' or new cherry seeds, new trees may come. It was just to produce these seeds in order to have new

plants, that the tree or plant sent its roots down into the soil to prepare and drink up the food. It was for this that all the green leaves spread themselves out in the sunshine and the rain, cooking the food, breathing for the tree, and helping it to grow. All of it was done for the sake of the 'children' of the tree, its seeds."

"I thought cherry trees were meant to give us cherries to eat," exclaimed Ruth.

"I am sure God was thinking of his human children when he made plants and trees that produce food," answered mother, "just as I am sure that he likes to have us enjoy the beauty and brightness of the flowers. But both the color and perfume of flowers, and the rich pulp of the fruit have another part to play, in addition to their service to us, as we shall learn a little later."

"Do all flowers have stamens and pistils, and make seeds in the same way?" asked Ruth.

"In the same general way, yes," replied mother, "though plants vary greatly as to number of stamens, the way the pollen boxes open to let the pollen out, the number and the partings or cuts of the pistils. Look at this buttercup, for example, and tell me how many pistils it has."

The children bent to look at the buttercups, and Don exclaimed:

"Where are the pistils? I can't find the sticky ends, but these little things in the very middle do not have pollen, so they must be pistils, and there are ever so many of them."

"You are right," said mother. "The pistils are so small you cannot see the sticky end; and they are many in number, all fastened to the cone-

shaped little object you see in the very center. Some flowers have a single pistil that will be quite likely to catch you napping, for you may say the flower has two or three or six pistils, when it really has only one, but cut into parts at the top. It will be interesting for you to look at all the flowers you find after this, and see how many things you can find out about their stamens and pistils, the number of each, and the ways in which the pollen boxes open. You will find some curious ways of arranging stamens too. The pea family, for example, always hasten stamens, and nine of them grow quite close together, while the tenth always stands at some distance from the others."



"It is easy to tell the stamens and the pistils in flowers like our Easter lily or the tulips, because they are so big and dusty, but these flowers do not have any green cup, any calyx, I mean," said Ruth.

"Be careful!" said mother. "It is not strange that you should think these flowers have no calyx, but the wise folks tell us that if one cup is missing it is not the calyx, even though the cup that we have is a brightly colored one. So we will call

these the *flower leaves*, and then we will be sure of making no mistake."

"They are lovely, whatever name we give them," said Ruth, burying her nose in the white lily cup and lifting it well dusted with yellow pollen.

"Indeed they are!" answered mother. "You remember what Jesus said of the beauty of the lilies, do you not?"

"Consider the lilies," quoted Ruth, "'how they grow. They toil not, neither do they spin; yet I say unto you, Even Solomon in all his glory was not arrayed like one of these.'"

"I like to think Jesus loved the flowers too," she added.

"He often spoke of flowers and of the beautiful things growing," said mother. "He used the flowers to teach us a lovely lesson of trust. Pointing one day to the lilies and the fresh grass, he said, 'If God so clothe the grass in the field, . . . how much more shall he clothe you, O ye of little faith?' Think what a barren world it would be, how impossible it would be to live, if God had never created 'every plant of the field,' and 'every herb of the field' to clothe the earth, and to play their share in carrying out his great plans."

"I thought flowers were made just to be pretty," said Don, "but they are more than that; they are a part of God's plan for seeds and new plants, aren't they, mother?"

"Yes," agreed mother, "parts of a very wonderful plan. Even their beauty and perfume have a reason for being besides the pleasure that comes from them, and we will learn about this in a few days."

Something to do:

1. Pick a common flower and learn to know its parts.
2. Draw or trace the parts of a flower, and mark each with its name.
3. Learn to know ten common flowers in your neighborhood. Make a list of the names, and opposite each name write the parts which that flower has.
4. Make a "beauty spot" in some place where no flowers grow, by sowing flower seeds, weeding the ground, and tending the plants when they need your care.
5. Select some flower, in your garden, in a window box, or in the woods, and mark it so that you can easily find it from time to time. One way is to tie a string to the flower. Watch the growth of the flower, from week to week. What happens when the petals fall off? What color was the flower? What insect visitors did it have? What is the seed? How many facts about it can you tell?

To learn: Luke 12. 27.

To read: "Discontent," a poem by Sarah Orne Jewett.

LESSON XIII

ROOTS OF MANY FORMS

... If the root is holy, so are the branches.—Romans
II. 16.

“‘STOREHOUSE’ roots for dinner!” cried Ruth one day, as Don set on the kitchen table a basket filled with young beets, crisp radishes and yellow carrots, from the garden. “Aren’t they pretty, mother? And the green leaves of the carrots look like feathers, though I think I like flowers better than leaves. Why don’t carrots blossom too?”

“They do, child,” laughed mother, “though you probably have never seen a carrot in bloom. But you remember the tiny carrot seeds you sowed in the garden last spring. How did you think the plant produced seed if there were no blossoms?”

“But why do we never see the blossoms, mother?” asked Don.

“Beets, parsnips, radishes and other plants that have fleshy, or, as Ruth called them, ‘storehouse,’ roots we name biennials,” answered mother. “That means that they require two seasons to produce their seed. In the first season, the plant is very busy indeed. What do you suppose it does?”

Ruth shook her head in doubt, but Don cried, “I can guess! It makes a ‘storehouse’ root.”

“Exactly!” replied mother. “It does not try to blossom at all, but stores all the food and drink it can, in its fat root. When the next season comes,

it is not necessary for the plant to lay up a supply of food before beginning to bloom. It soon sends out its flowers, and it feeds these and the seeds that grow from them with the food it has already in waiting. If you were to let a radish grow the second season, till the seeds were ripe, you would find, if you dug up the root, that it was withered and flabby."

"Then we use storehouse roots just because they are storehouses, and have food in them," said Don. "Imagine chewing on the thready roots of plants! Ugh! wouldn't they be tough?"

Ruth laughed at the look of disgust on Don's face, then turned to mother to say:

"All roots grow in the earth, don't they? That's one way you know they are roots."

"You are mistaken," laughed mother. "Roots have many queer ways. Don, please bring me a spray of the English ivy that grows on the chimney."

Don ran to the side of the house, and soon returned with a long branch of ivy.

"My, but this vine held tight!" he said. "I had to pull ever so hard before it let go."

"With what did it hold fast?" asked mother.

"Oh, mother, you know," he responded; "all these queer little things that grow along the stem."

"These queer little things," said mother, "are roots—little air roots, that do not help the ivy to get its food at all, but they do help in another way, the way that you learned."

"You mean holding the vine fast to the wall?" queried Don. "They are good at that, I can tell you!"

"Indeed they are," agreed mother. "There is another sort of air root you will like to see and know about. We will stop at the florist's some day and ask him to show us his orchids. These are strange and lovely plants, many of which come from South America. They often grow on the branches of trees, where their seeds have found a lodging place. Here a few 'hold-tight' roots may keep the plant from falling. But these are not the feeding roots. The feeding roots hang loose in the air. The end of each one may be covered with a queer, spongy stuff, and it is this that sucks in for the use of the plant, the food on which it lives—air, water, or various gases. You see, one kind of orchid is a true air plant. Some orchids grow upon the ground, and some in wet marshy places."

"Earth roots, air roots," repeated Ruth. "There ought to be water roots, to finish the list."

"There are," smiled mother. "Some of them are more earth than water roots, but they are such thirsty roots that they often play much mischief with the drains in city streets. They find a tiny crack or crevice in a drain pipe, and first one wee root, then another, will force its way into the pipe. At length the pipe gets so full that the growing roots break it, and a leak comes. In some cities this has happened so many times that it has become necessary to forbid the planting of such trees in places where they may cause damage."

"What about the roots of plants that grow in water?" asked Don.

"Some of them are real feeding roots," answered mother, "and may take the food from the water. Others, belonging to plants that grow in shallow

water, may have roots that are planted in the mud. Some are just 'hold-fast' roots. I have found them on the beach sometimes, washed up after a storm, and often they are fastened so securely to a stone or rock that they cannot be cut away."

"Earth roots, air roots, water roots," said Ruth, counting them off on her fingers. "Was that all, mother?"

"No," answered mother, "there are some roots that find still another place in which to grow. There is a queer, ghostlike little blossom that I used to find in the woods when I was a little girl. It is called Indian pipe, and is shaped very much like a pipe. It is a waxy white. If you were to find it, you might think at first that it grew out of the ground; but if you examined the spot carefully, you would find that under the loose soil there is decaying vegetation of some sort, usually an old log, in which this odd little plant has its roots. Broom rape is less striking than the Indian pipe, being much smaller, and of a pale, dull color, but it grows in much the same sort of place. Then there are several well-known plants that live on other plants. Do you know the name of one?"

"Oh, yes," cried Don. "I remember! Grandfather showed me some dodder last summer. It looks like a mass of yellow threads. It grows on the stems of other plants, and lives on the food they bring up, without doing anything itself."

"That is quite true," said mother. "It starts out in life from the little seed, but never makes any effort to get its own food. Instead, it sends up a shoot that feels about for the right kind of a branch

on which to fasten and then it sends its shoot down into this, and drinks up the food that the plant has prepared for its own use. Sometimes the dodder gets into flax fields, and chokes to death all the plants that a farmer has tried so hard to raise in order that we may have our linen towels and handkerchiefs."

"I don't like the dodder very much, mother," said Ruth. "I hope no other plants are like that."

"The mistletoe," answered mother, "always feeds on other plants, very often choosing the oak. The seeds drop on the branches from other mistletoe plants, or they may be carried by birds. They send out little roots that find their way into the branches as the earth roots of other plants find their way into the ground, and presently you may see on some fine old oak a great mass of green, quite unlike the oak leaves. Then you know that the mistletoe has made itself at home, and is sucking the oak juices."

"I won't be dodder or mistletoe," said Ruth, shaking her head decidedly. "I'll use my own roots and do my own work. I'd rather be a beet or a carrot than dodder."

"Or a good honest oat plant," laughed Don. "I read last night of one oat plant that had a root one hundred and fifty feet long. Think of that—some distance for a little oat plant to send out for food and water, wasn't it?"

"It was a well-rooted plant, indeed!" said mother. "It is a splendid thing to be well-rooted, whether you are a boy or a girl or a growing plant. You remember the parable of the sower, and what Jesus

said of the plants that withered quickly in the hot sun—they had no root. If you depend too much on others for work or fun or thinking, you are not sending down good roots—you are like the dodder or the mistletoe. The Bible speaks often of the importance of good roots. 'If the root is holy, so are the branches.' Paul prays that the Ephesians may be rooted and grounded in love. Let the roots teach you a lesson, and whether you are to be an oak or an oat, a man or a woman, make sure of good roots!"

Something to do:

1. Find a picture, or make your own drawing, of plants that have different kinds of roots. Name each root.

2. Make a list of roots that give man food.

3. Find a moist place and a dry place, in the lawn or in a lot, where weeds are growing. Carefully pull up two or three weeds from each place. Perhaps you can find the same kind of weed in both places. Compare the roots from the two places; how do they differ? What is the reason for this?

4. Sow a few seeds as directed in Lesson XI. Examine the roots under a magnifying glass and see if you can point out the tiny root hairs. What happens to these hairs when the water in the dish dries up? What happens to them when you touch them with a pencil?

5. Place two wide-mouthed bottles side by side, and fill one about half full of water. Put a thick cord or a twist of rag into the bottle with the water, letting the end of the twist come down into the water, while the other end hangs over in the empty bottle. Leave the bottles for a day or more, and note what happens. Ask your teacher to help you find what *capillarity* means.

Does this experiment help you to understand how the water and the sap get from the roots of a plant to the leaves?

6. Look at the stems of plants, and bring to the next session of the class as many different shapes and kinds of stems as you can find.

To learn: Proverbs 12. 12b; *or* Ephesians 3. 17.

LESSON XIV

PLANTS AND THEIR STEMS

WHAT is a stem? What does it do? What shape is it? If you had been asked these questions two or three days ago, would you have answered something like this?—A stem is the part of the plant that holds up the leaves, and it is generally round. Perhaps you might have used those very words, but if you had been asked to bring in to this class as many different kinds of stems as you were able to find, I suspect that you would wish to change some parts of your answer, and before we finish this lesson you may wish to change it still more.

You may think that the stem has no very great part to play in the life of the plant, other than to hold up leaves or flowers, and that there is little for us to learn about it. You remember one lesson we learned when we were studying the earthworm is that it is never wise to overlook small or simple or plain creatures or parts. Perhaps we shall find that stems have a fine lesson for us too.

One of the first things we learn when we begin to study plants is that all of them are named from the kind of stem they have. One division is made according to the length of time a stem lives. All plants whose stems live one year, and then die down—at least as far as the root—are called *annuals*, from a word that means “yearly.” Some plants, as you learned when we were talking of the carrot,

live through two years, and these are called *biennials*, for *bi* means "two."

But other plants live much longer; their stems last from year to year, and such plants are called *perennials*. *Per* means "through," so you see the word means that these plants have stems that live *through* a period of years.

But this is not the only way in which plants get their names from the kind of stem they may have. Did you ever think of the difference between a *shrub* and a *tree*? Both are perennials, both have woody stems. The tree is larger, that is, it has a larger stem, and this stem does not divide for some distance above the ground. The shrub not only is smaller than a tree, but it divides into branches either at the ground or at a very short distance above it. *Herbs* may have either annual or perennial roots, but they have annual stems, and these stems are not woody. You will enjoy making lists of trees, shrubs and herbs, of annuals, biennials and perennials, and you will remember when you do so that these names are given plants because of the kind of stem they have.

In what direction does a stem grow? Up, do you say? That is very often true, but not always. If you plant a grain of corn in the ground, it will send up a stem that grows tall and straight, and that stands by itself almost as steadily as a soldier. Wheat and oats, while not as strong as corn, will stand straight and alone. So it is with many other plants that you can name.

The pea vine is not like the corn. It cannot stand alone. It creeps along the ground until it comes to some other plant, a pole, a fence, or some-

thing which will hold it, and then it begins to climb, by throwing out a leafless threadlike branch, which we call a *tendril*. This is quite straight at first, and reaches out until it touches some object that will support it. Then it begins to coil around the support, taking the shape of a spring. You can see at once what a fine "hold fast" such a tendril makes, for the coils "give" and stretch and yet they keep a firm hold on the support. Grape vines send out tendrils much like those of the pea. Can you find other stems that help their mother plant in just the same way?

Some stems, unable because of their great length to hold themselves erect, twine around the support, instead of making tendrils. The hop vine, so common in some parts of the country, is one of these, and the queer thing about the hop is that it always twines in the direction of the sun, and no training will make it do otherwise. The bindweeds, or, as you may call them, the wild morning-glories, twine about the support, also, but they twist *against* the sun.

Our woodbine grows tendrils, but these do not twine around wires or other supports. When they reach the wall on which the vine is growing, each little tendril end flattens out into a sort of suction cup, and this clings fast to the wall.

Some plants, like the strawberry, have stems that run along the ground, and at a little distance from the mother plant send down roots, from which new plants come. There is another very common plant that we all love which has a stem like this. If you look for it, you will probably find it at home in your lawn, though you perhaps did not know before that white clover has a stem of this kind.

Certain plants with stems too weak to stand erect find yet another way of support. You find a good example of them in the water lily. You know how long the stems of these lilies are, and yet how weak they seem as soon as they are taken from the water. What kept them standing before they were gathered? Yes, it was the water; they floated on it like cups.

But you will begin to think that the chief end of the stem is to hold the plant in place, and this is indeed a very great service. However, stems have not finished their work when it is done. Many of them wear armor to protect the plant from its enemies. These enemies may be insects, or they may be animals that like the fruit or the leaves of the plant. The size and the kind of armor depend on the enemy that must be kept away.

Let us suppose that ants or other tiny insects are the enemy. Do you ask what harm these may do? You know that many blossoms secrete in their cups a sweet substance that you call nectar. Some insects like this as well as does the bee. The bee, however, is the only one that repays the flower for the nectar she carries away, by doing a service to the flower. What this service is we shall learn a little later. Suppose now that ants and other insects too small to be of benefit to the flower came and ate all the nectar? When the bee came for her share there might be none, and soon she would stop coming at all! Then the flower would indeed be quite helpless. To prevent this the stems act like guarding soldiers, and send out some barriers to the little would-be visitors, who would take all and make no return.

In some plants this barrier is often a great number of stiff hairs. You will find many plants in which these hairs point downward. To the little insect that would crawl up the stem and suck the sweet juice, such a forest of hairs must seem like a vast and tangled wood.

You have seen mother put out sticky fly paper to catch the dangerous housefly that would like to get into the clean kitchen and eat of your food. Probably you think sticky fly paper is the result of a bright thought of some clever man or woman. Long before man ever thought of such a thing the little wild pink that grows so commonly in dry and sandy soil throughout the Eastern States had protected itself in this way. Its pink cups are kept safely from robber insects by a sticky gummy substance around each stem. You can see something of the same sort on the stems of mother's petunias, and I think you will agree that such stems play the part of plant protector very well indeed.

Different plants use different ways of protection. Some of the stems grow prickles, like the rose or the raspberry bushes. You can imagine that no animal, even if very hungry, will try these plants for a meal. You may have walked in an old pasture some time, and seen how the cows and sheep nibble all around the brier bushes, but take pains to keep far enough away to avoid being scratched by the pricks.

Some stems do not stop with mere prickles, but grow thorns, which are not just on the skin of the stem, but grow out of the stem itself. It has been found that such thorns often disappear when

the plants are brought to our gardens and cultivated. The wild apple, or crab, as it is sometimes called, is often thickly armed with very long spikes. I once found a cluster of old crab trees on the edge of a little forest. It was early in spring, and the trees were a mass of the loveliest pink bloom imaginable. But every branch of every tree, big or little, was armed with very sharp thorns, some of them two or three inches long. They stuck out in every possible direction, and made getting a few blossoms dangerous indeed. So you can see these stems guarded the mother plant's treasures well.

You will be interested in making lists of stems that guard the plant, and of the ways in which each does this important part of its work.

Stems have still another part to play in the life of the plant. You remember that you found out that the potato is really a stem, an underground stem. What does such a stem do? Yes, it acts like the storehouse roots and lays up in itself the food which the plant has taken from the ground. So much food does the potato store away that it is quite possible, as you very well know, to cut a large potato into several parts, if you are careful to have an "eye" on each part, and get a new plant from each part. Such stems are called *tubers*.

Other stems that are underground growers are often inclosed in layer after layer of scales or leaves. Such stems are called *bulbs*. Lilies, the crocus, the onion, the leek, are stems of this class. How many others can you find or name?

So far we have been thinking about the uses of the stem to the plant, and this is quite the correct

way to think of it. But it will be an interesting study for you to try to discover in how many ways man uses the stems of plants for himself. You will find some are good for food. Out of others we make baskets, chairs, clothes, curtains, canes, fishing poles—but I am not going to spoil your fun by making the list any longer.

I am sure you will never again think that it is only the stem, for you know now that the stem is a very good helper in the plant life, even if it seems less beautiful than the flower. The stem ought to help us learn that every part, no matter what it may be, has its special place and its own work to do. This is the way God, in his wisdom, has planned it all, and what seems very plain or insignificant may be of greatest service, after all. You remember that Paul tried to explain this to the Corinthians. He used the body instead of the plant to teach this very lesson. He said: "The body is not one member, but many.... Those members of the body which seem to be more feeble are necessary.... The members should have the same care one for another." Do you not think the stems have had a fine story to tell and a fine lesson for us to learn?

Something to do:

1. Make a list of biennial stems; of perennial stems; of annual stems.
2. Make a list of shrubs; of trees; of herbs.
3. Find ten plants that guard their flowers or seeds by the help of the stem. How is this done?
4. Write ten things you use every day that are made from stems.

5. How long a list of stems used for food can you make?
6. Write a guessing story about a stem, and read to your classmates. Here is a sample: "I am a green stem, and stand erect. The leaves grow from me, first, from one side, and then, a distance farther up, from the other side. Short, sharp spears grow all over me, with curved points, all bending downward." Answer: A rose stem.
7. Think of the different stems of which you have studied. Write out a list of your very own—strong stems, clinging stems, climbing stems, standing stems, weak stems, and others that you will think of. What is the best thing you can say of each kind of stem? As a boy or a girl, which stem do you choose to be like?

To learn: 1 Thessalonians 5. 21; *or* 1 Corinthians 16. 13.

**He causeth the grass to grow for the cattle,
And herb for the service of man;
That he may bring forth food out of the earth.**
—Psalm 104. 14.

LESSON XV

GREEN LEAF FACTORIES

YOU have learned that all plants have roots, and you know what the roots do for the plant. You have discovered that many plants have stems to carry them up to the light, to support them, protect them, or to serve as storehouses for food. You know too that plants cannot live without leaves. If you suppose for a minute that the dodder is an exception to this rule, you recall that, though the dodder does not put out its own leaves, it uses the food prepared by the leaves of the plant to which it has fastened itself.

You know that the watery food is carried up to the leaves to be cooked by the sun. Perhaps you have proved this by placing a white lily or a white carnation in a glass of water to which you have added red ink or green dye. You have proved by experiment, too, that leaves throw off the extra water by perspiring.

But the plant depends on the leaves for a supply of food that is not brought up out of the ground, but must be taken from the air. This food is called *carbon*. Not all of the leaf is able to get this food from the air, but certain very special cells have this to do. In these cells there is a substance that the wise men call *chlorophyll*; it is this that gives the green color to leaves, and it is often spoken of as *leaf green*.

When you are a little older you will no doubt study chemistry, and then you will find out the most fascinating and wonderful things about the substances that make up the air we breathe in and out of our lungs. Each substance is called a *gas*. Two or more of these may join, and make a different kind of gas. You know mother may take a brown powder out of one of her tin cans, stir it in milk, add some water, perhaps, and put in sugar. You do not call the cooked mixture water or milk or sugar or powder; you say it is *cocoa*. So when the gases have joined, we do not call them by their individual names, but give a new name to the mixture.

As I said, plants need carbon, and this is found in the air, but it is joined very closely with another gas called oxygen, and the two gases joined together are known as carbonic-acid gas. You can guess how hard it would be to separate the sugar, the water, the milk and the powdered cocoa from the drink mother makes for you, and put them back into their first forms. It is something like that that must be done to the carbonic-acid gas if the plants are to have the carbon they need.

But the chlorophyll, the leaf green, can do this hard thing if it can have the right help. This is not very hard to find, for the help is in the sunshine. The sunshine and leaf green, working together, break up the carbonic-acid gas into carbon and oxygen. Then the plant takes the carbon to use, or to store away for food, and throws the oxygen back into the air.

Now you can see why plants need sunshine for good growth. The leaf green cannot get the needed

carbon at night, or on cloudy days; it must have the help of the sunshine.

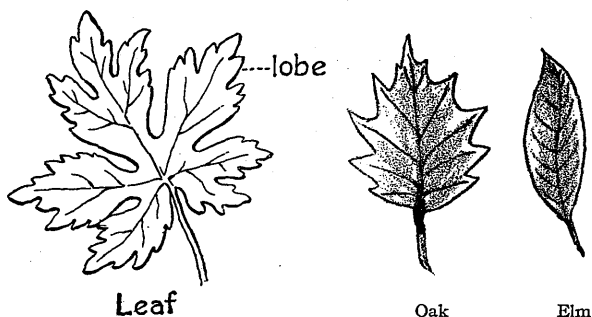
Perhaps you wonder how a plant uses carbon for food. It is very soon changed into starch, and this is stored in the leaf as long as the leaf can keep on making it. But when the sun sets, or goes under a cloud, the leaf begins to digest the starch and change it into sugar. Now you know starch will not dissolve in water, but sugar will. When the food has been changed to sugar, it is carried to other parts of the plant. Here this and other digested foods are combined with the living substance of the cells, to make sap, new cells, tissues and substances like oil, resin, or wood, as the plant may need.

You see, then, that all plant and animal life depends on the sun, for there is no animal life that does not depend, in the end, on plant life for its own life. Those animals that form the food of other animals are fed by plants. But plants cannot live without the carbon, and this they cannot get without the sunshine. It is like a long chain, is it not, that reaches back to the sun? When you eat a piece of bread or a fine red apple or a juicy lamb chop, you are eating food that leaf green and the sun made possible. But the sun does its work, gives its heat, and sends out its strong light in obedience to the laws of God, who placed it there in the sky, and set it on its ceaseless journey. It is God whom we thank for daily food and light and life.

I am sure you marvel at this wondrous plan by which God has given all his creatures food and life. But it is not only in big things that God has

shown us his power and his infinite skill; we can read it in many ways that seem simpler, at least at first.

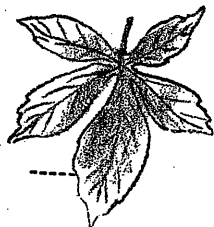
Did you ever stop to think of the very great numbers of leaf-patterns? Or did you ever look at a tree and think how well fitted to that tree its own leaves and branch arrangement are? Here is a good game to play with your imagination some day; it will help you to open your eyes, and make you see God's wisdom more clearly than ever before. Remember first what leaves are for—their leaf green is to work with the sunshine in getting the much-needed carbon for the plant. This means,



then—does it not?—that the leaves must be spread out in the sunshine. Now, look at a pine tree and study the way its leaves are arranged. Then, in your mind, change the pine leaves to a maple tree, and the maple leaves to a pine tree. Or, in your imagination, put oak leaves on an elm tree, and beech leaves on a maple tree or chestnut leaves on an apple tree!

You may laugh at the idea of changing the dresses on the trees, even in imagination, but to

do so will help you to study the reason for the form of the leaves and their arrangement. Ask yourself a great many questions about the leaves. Why does the horse-chestnut leaf have such a long stem in some parts of the tree? Why do the young leaves of the sunflower turn to the sun all day? Why do so many trees have their leaves arranged spirally round the stems? Why does the thistle leaf grow such spiny points? Why do some grasses have such a sharp, cutting edge? Why? Why? Why?



Horse Chestnut

Of course you can answer the question about the thistle and the grasses with the cutting edge at once, especially when you think about protecting stems. Then you will wish to find other ways that leaves have discovered for protecting their plant's life. For example, why do the cattle seldom eat the big green burdock leaves? Not altogether because they do not like to get the burs in their coats, I think!

Still another way in which leaves help the plant is by acting as water distributors. If you never thought of this, go to the garden and study the way the plants carry their leaves, and you may often learn very much about the root arrangement. The canna, for one illustration, folds its leaves up to form a sort of funnel, down which the rain water runs. You will find the canna roots do not go far from the center of the stem, and so they get the water that the leaves shed. Another plant that you have heard called Elephant's Ear, from its big leaves, sends the water off in a great circle, and you

would find, by digging down, that most of the roots reach out to this circle. How do the beet and the radish arrange their leaves? What is the shape of their roots?

The leaves of plants will not only tell you about the roots that you cannot see, they will tell you what sort of a stem belongs to the plant. Some leaves, like corn and lilies, have little veins running in straight lines, side by side; they do not cross one another. Such plants have stems like the corn, or the palm. The woody fiber is in bundles all through the stem.

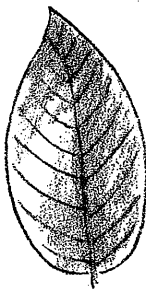


Grass

Other leaves have their veins arranged in a crisscross fashion; they seem to cross each other very many times. Such leaves belong to the maple, the oak, the geranium, and many others of our



Sugar Maple



Walnut



Orange

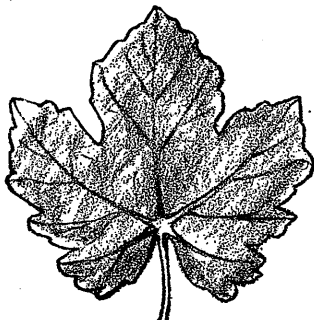


Rose

common plants and trees. The stems of these plants have the woody fiber arranged in rings rather than in bundles. If you cut a round slice from a cornstalk and another from a rosebush or a

small branch of an elm, an oak or a maple, you can easily prove this for yourself.

A fascinating part of leaf study has to do with their shapes. What a wonderful variety of forms you find! Some leaves are long and narrow. Some are very deeply cut. Some are in three parts, like the clover. Others have many little leaflets along both sides of a stem. Some are pointed, while others are round. Some



Grape

have the stem fastened at the end, and others, like the nasturtium, have the stem in the middle of the leaf. Some leaves have smooth edges, others are curved, or cut like saw teeth, or they may be just irregular, without following any set pattern. Look carefully at as many leaves as you can find and then see how correctly you can draw them from memory. Do this over and over, till you are able to reproduce the leaves, and to recognize the tree from which each comes, immediately. It will help you to see clearly what you look at. It will make you love leaves more than ever. Perhaps you will like to make blue prints of leaves for your schoolroom decorations when the real leaves have gone. This will help you to see God's plan of order and beauty for the world, for you will remember that nothing came just by chance in all God's wonder world, and nothing that he has made in the plant world is more worthy of our study than the green leaves.

More than once the Bible compares the good man to a healthy tree "whose leaf shall be green," or "whose leaf doth not wither." Find these verses and learn them, to help you remember the leaf's lesson for you.

Something to do:

1. Secure some architect's or "blue-print" paper. Open it only in a darkened room, and cut it in pieces of any size you wish. Lay a piece on a board or slate with the sensitive or colored side up. Arrange on this one or more leaves in a pretty pattern. Cover this with a sheet of glass and carry it all where the sun will shine brightly on it. In a few minutes the paper that is not covered by the leaves will turn a dark blue. When this happens, remove the glass and leaves, and wash the paper in cold running water till all the color has stopped running from it. Dry on blotters or old paper. Arrange in a book, or as a border for your schoolroom.

2. Make in your notebook a picture of a lily leaf, a grass blade, or a corn leaf. How many other parallel-veined leaves can you find?

3. Make a picture of a maple leaf, a geranium leaf, or an apple leaf, showing the veining. Write five other leaves that have veining of the same type.

4. Decorate a card with pressed leaves, a blue-print leaf, or a drawing of a leaf. Write below the decoration a verse from the Bible about leaves. You will find one in Psalm 1. Use the finished card as a gift to someone whom you love.

To learn: Jeremiah 17. 7, 8.

And on this side of the river and on that was the tree of life, bearing twelve manner of fruits, yielding its fruit every month; and the leaves of the tree were for the healing of the nations.—Revelation 22. 2.

LESSON XVI

A FIELD DAISY AND ITS FAMILY

"JUST a common field daisy," do you say? You know all about it? Then you may tell its story. Yes, it is a common flower. It has a bright yellow center, with white leaves around this. It grows almost everywhere, and the farmer dislikes it growing in his fields because it is difficult to root out, once it gets a good start, so careful farmers do not give it a chance.

Now, let me ask you just one question about the daisy. How many flowers did you pick when you pulled a single daisy head from the green stem? One, you say. It is not strange that you think so, but you are quite wrong. I cannot tell you how many flowers you did pick, for I have no way of counting them accurately, but in that one daisy head you have a very great many. But do not feel ashamed that you did not know. Probably half of the grown-ups whom you meet would say that you must be right. The little green cup on the under side looks much like the leaves you have been taught to call the sepals of the calyx, and the yellow center seems very like the stamens. But this cheery white and yellow head has deceived you, as you will soon find out.

If you can get a magnifying glass, you can prove a good part of what I am going to tell you for yourself. If this is not possible, a book about

flowers may have some pictures of the daisy very much enlarged. An encyclopædia may also help you. But without any of these, you can find out something about the daisy for yourself, and this is the best way to learn. What others tell you you may soon forget, but when you discover a new thing all by yourself, it is such fun that you will remember it without trouble.

First, then, take one of the daisy heads, and pull it apart. Look at one of the tiny yellow flowers that grow in the center. Yes, each tiny tube is a flower. It may not look much as we are accustomed to expect flowers to look, but it is a flower, and, small as it is, it is a perfect flower, with both stamens and pistil.

The little yellow flowers that are crowded together in the center of the daisy head are called the *disk* flowers, because they make up the disk, or wheel, in the center.

If, now, you look at one of the white leaves, you will see a tiny tube at the base. This is the real flower. It has a pistil but no stamens. The pollen must be brought to it from the yellow disk flowers by flies or other insects, if it is to produce seed.

The white leaves are called the ray flowers; you can remember this name because these flowers "ray" out from the center.

I am quite sure that you never before guessed that the daisy had this interesting secret, and that you are surprised to know what a number of flowers are crowded together in this one head. It is rather important that you should know about the daisy and the family or order to which it belongs, for it is the largest flower family in the world. The

name of the order is *Compositæ*, or the Composites. You can see what a good name this is when you stop to think that the heads are *composed* of many little flowers growing together on a stem as if they made up one flower.

It is thought that one ninth of all the flowering plants in the world belong to the Composites. Each kind differs from another, just as boy cousins or girl cousins may differ from one another. Just as boys and girls may belong to the same family, and yet one may have blue eyes and another brown, one may have straight hair and another curly hair, so the flower cousins may all be Composites, and yet be of many forms and colors. Wherever you go, you will find some of the Composites, so it is well for you to learn as much about them as you can. Look about you, and find a flower that you are almost sure is a Composite.

Yes, you are quite right. The dandelion is a Composite, and one of the most common. Does it puzzle you that you can find no tube flowers? The dandelion has only the ray, or strap, flowers, as they are often called, since they look like tiny straps. But each is a perfect little flower, with stamen and pistil.

You have such well-kept gardens and lawns that I am sure I cannot find in them another member of the Composites that will show a third arrangement of flowers. So I am going to ask you to walk with me in fancy through a pasture where the cows have been feeding every day for several weeks. You see they have eaten the grass till it is quite short. But here is something they seem to have kept well away from—it is the thistle,

whose leaves are armed for the very purpose of keeping off anything that might make a meal of it! Only the big bumble bees can reach it without getting pricked. But as we wish very much to inspect one of its pinkish purple blooms, we will risk a little scratching, and with a sharp knife we will cut off one of the heads. Be careful in handling this spiny bloom; and pull it apart. You will find, as you look at it through the glass, that all the flowers are tube flowers.

You have now the three ways in which the Composites arrange their flowers in heads. There may be disk or tube flowers in the center, with ray or strap flowers arranged around them. Such a head is found in the daisy. There may be a head in which all the flowers are ray or strap flowers, like the dandelion. There may be Composites with all the flowers tube or disk flowers, like the thistle.

One of the flowers that has the all-tube arrangement was very well known to our grandmothers. I wonder how many of you have ever heard of it? It is called *thoroughwort*. It grows in rather damp places, and has large clusters of dull, white heads. It was thought to be a most useful medicine, and our grandmothers who lived in the country used to gather great bunches of it in the summer and fall, and hang them away in the attic to dry. Then when people caught cold or grew feverish or seemed to need a tonic, a bitter tea was made of the *thoroughwort* leaves, and the sick person drank it! Perhaps your father or mother will be able to tell of a time when they wished one Composite had not lived near them, if they can recall this bitter tea!

One of the very common Composites that you

all know is the sunflower. It looks much like a huge black-eyed Susan. The big brown center is made up of tube flowers with stamens and pistil, like those in the white daisy's yellow center. The big yellow rays around the outside have neither stamen nor pistil, and of course can produce no seed. Yet they are the showiest part of the sunflower head, though they are the first parts to wither, curl up, and drop. Why is this, and of what use are these rays to the plant, if they make no seeds? It is just because they are showy that they are helpful. They hang out their bright yellow leaves like so many waving flags to say to the bees and butterflies that the sunflower nectar is ready. Then the insects come to the feast, and play their part in helping the flowers to make seeds, as we shall learn soon. But after the seeds are formed, the plant needs all its strength to send to the seeds to make sure of strong and sturdy plants another season. The plant cannot afford to send good food to the yellow petals when they can no longer help, and so the petals curl up and drop off.

Is not this a strange and wonderful plan for dividing the plant's work of making seeds between the ray and disk flowers? That's one reason why the study of any of God's wonder works is so interesting. You are always finding out new things that show his wisdom and skill in planning and caring for all things that he has made.

You will find many of the Composites in gardens, on the hillsides and in the fields. Asters blue and purple, dahlias, chrysanthemums, zinnas and marigolds, tansy, artichokes, chickory, the goldenrods, the yellow and white everlasting, all

belong to the Composites. Some of the heads are very small and the separate flowers are so tiny that you will need to take the greatest care in studying them, or you will make many a mistake. But you have already found out enough about the "common daisy" to be sure that it and other members of its family have many interesting things to tell you. Study them with patience. Watch for the insect visitors that come to each of them, and make lists of them. Does the dandelion have the same visitors as the goldenrod? Do the insect visitors that come to the sunflower help or harm it? Do dahlias and chrysanthemums make seeds to insure new plants, or do they provide some other way for the plants of the next season? Try to find the answers to these questions by yourself, and ask a great many more. In this way you will get your eyes wide open to the beauty and the wonderful fitness of these many plants. You will be ready to say that God's world is indeed a wonder world, and you will thank him that he lets you "think his thoughts after him," for you will say: "He has made everything beautiful in its time."

Something to do:

1. Look up at the library the story of the Shasta Daisy and tell what Luther Burbank had to do with it.
2. Tell the story of Luther Burbank, and write a short account of a useful thing he did.
3. Look for members of the Composite family in your own yard, meadow, or park, and see how many you can find and name, of those that grow wild.
4. How many Composites grow in your cultivated garden?

To learn: Psalm 65. 9.

To read: "Daisies," a poem by Bliss Carmen.

The grass withereth, the flower fadeth; but the word of our God shall stand forever.—Isaiah 40. 8.

LESSON XVII

BEES AND FLOWERS

... Study to be quiet, and to do your own business, and to work with your hands.—1 Thessalonians 4. 11.

WE have spoken several times about the visits of bees and other insects to flowers for the sake of getting the nectar that is hidden in the flower cups. We have hinted that the insect performs a service for the flower in return for this sweet juice. It is time now to talk of this service, and to see just how the flower is helped by the visits of bees, moths, and other guests.

We must first go back to our story of the flower and its parts. What is the work of the stamens and the pistils? You remember when the pollen grains ripen in their little cases that these open, and then the pollen grains fall on the moist top of the pistil. They there begin to swell till the outer case cracks open, and a tiny rootlike tube begins to grow downward to the box in which the baby seeds are packed away. The tube carries a bit of life substance from the pollen to mingle with the life substance hidden in a wee seed-that-is-to-be. When this mingling has taken place the seed begins to grow. This whole process is called *fertilization*.

It has been found that better and stronger seeds are produced when *cross* fertilization takes place. Cross fertilization happens when the pollen from one flower falls on the pistil of another flower of

the same sort. Since flowers by themselves cannot gain cross fertilization, some plan must be followed by which the pollen can be taken from one flower to another.

Writers quite often speak of flowers learning to attract the bees and other insects, almost as if flowers had minds, could see what help the insects may be to them, and then went about getting this help. Do you not think it is much more reasonable to believe that God planned that the insects and the flowers should help each other and carry out together the work he has for them to do?

How do insects help in the fertilization of flowers? I think you have already guessed the answer, in part at least. They come to the flower for nectar; they get their wings and feet dusted with the yellow pollen; they fly to another flower, and in alighting on that, they scatter grains of pollen on the moist pistil top, and cross fertilization has been accomplished. This is the whole story in a word.

But there are many points that have been left out. In the first place, how do bees and butterflies and other helper insects know that the nectar feast is ready for them? If you were to pass along a road near an apple orchard in full bloom, how would you know that the trees were blossoming? Yes, both your nose and your eyes would tell you! Some people think most insects do not see very far, and are chiefly attracted to flowers because of their fragrance. Others believe that the gay petals of apple and cherry and peach blooms and of scores of other flowers are like banners hung out to tell the insects that flower-land goodies are waiting for them. At any rate, the insects seem never to

make a mistake in the time. They accept the invitation of the flowers; they come and sip the nectar; they carry away some of the pollen, and scatter at least a part of it on the next flower they visit.

It is quite necessary that the pollen of any flower should be carried to the pistil of a flower of the same kind. If the pollen of a pear bloom should be carried to the pistil of an elm or a maple tree bloom, neither pear, nor maple, nor elm seeds would result. The pollen must be carried to another pear bloom.

You will remember that we found the bee goes always to only one kind of flower as long as she can find that flower. You see at once how much this helps in the matter of fertilization. The bee is not a wanderer from one kind of flower to another. If she starts to gather nectar from apple blossoms, she visits apple blossoms one after the other. If she is making honey from white clover, white clover is her choice as long as the clover lasts.

I am very sure this does not happen by mere chance. Nor is it just a queer habit of the bee. It is a part of God's plan for both bee and flower. As we study this interesting story of cross fertilization, and as we find new ways in which the flower attracts the insects, as we say, tell yourself over and over again that it all belongs to the wise and careful provision of our heavenly Father for his creation; he cares for bee and flower, for bird and worm, for all things that he has made, and in his loving eye there is no great and no small.

In all God's great wonder world you will find no more interesting story than those that are

written on many of our flowers for wide-awake persons to read. Some of them are very simple and easy; others are very hard indeed to make out. Some flowers have hidden their secret so well that the wisest students have to think long and observe well before they can find them out.

If you would like to read one of the most interesting stories, pluck an iris, or, as you may prefer to call it, a blue flag, from your garden bed.

You will note that each flower has nine parts. The three large lower parts—blue, violet, or purple—are marked with white and yellow, and with lines of darker purple. These lines are sometimes called the “honey guide lines.” Bees seem to especially love blue and purple, and if you watch your iris bed on a sunny day, you may be lucky enough to see Madam Bee arrive at the door of the blue flag in search of honey. Almost surely you will see her alight on the top of the flower, where three other petal-like parts curve out over the first three. You might never guess it all by yourself, but these three parts make up the pistil of the flower. If your eyes are very sharp, you may see that Madam Bee is well dusted with pollen. Of course she cannot help scattering some of this on the pistil. You will remember that she has come to this iris from another iris. But where did she find the pollen? You have seen none on this flower. Watch the bee, and you see her follow the honey guide lines and disappear into a curious pocket. Lift the top of a pocket, where it curves over, just below the third set of erect little parts. You will find, cunningly tucked away, a slender yellowish stamen, well supplied with golden pollen.

It is so placed that the bee cannot possibly get away without brushing off a part of it and carrying it with her on back and legs. She flies off to the next waiting pistil, and the cross fertilization has been made! Is it not a clever plan?

The mountain laurel has a wonderful fertilization plan. If you ever get a handful of the lovely pink-and-white blossoms, make a careful study of the way fertilization happens in this plant. Each single flower cup of the large cluster in its pretty circle of bright green leaves has a row of fairy pockets, arranged like a belt around the cup. There are always just ten pockets, one for each silvery stamen. Of course you do not need to be told that the treasure the stamens hide in their pockets is the yellow gold of the pollen. Each stamen tip, with its box of pollen, is snugly tucked into a pocket, and there it stays till the pollen is ripe. Then the pockets grow a little loose, and the stamens wait for their helpful visitors to answer the gay invitation of the blossoms. Soon they come, bee or moth or butterfly. Of course they alight on the cup; that is, in the very center of the stamens, whose tips are still tucked in the pockets. But the instant the stamens are touched, the most astonishing thing happens, for S-N-A-P! All the heads pop out of the pockets, and a shower of yellow pollen is sent flying in every direction. Some of it is lost, but much of it falls on pistils outside of the cup in which the pollen grew, and so once more cross fertilization has been secured. If you are not fortunate enough to see a bee or a butterfly in the very act of helping the flower, you can see how the plan works by touching the stamens with a

straw or a pin, when they will snap as if a bee had alighted on them.

Have you ever driven along a country road in the early evening, and seen the primrose getting ready for her visitors? She wakes up when the sun is low in the west. She decks herself in a bright yellow gown, and sends out the sweetest perfume to call the moths to her. But she hides her nectar so far down in her cup that only the long-tongued moths can reach it. If none of these happen to come to her feast during the night, the primrose will stay awake after the sun comes up, waiting for a hungry humming-bird to come along for breakfast and to carry off the pollen. The primrose has another clever part to her plan. She has many buds on her stalk, but she opens only one at a time, so the moth or bird visitors are obliged to carry the pollen to a flower on another stalk.

The columbine follows an interesting plan. You know its odd shape, with the five little horns hanging upside down on the stem. In the very tip of each horn is stowed the sweet nectar. Can you imagine a bee or a butterfly hanging head down to get the sweets of the columbine? But there are two helpers that find no trouble in doing so. Watch and you will some day see that funny little acrobat, the bumblebee, clinging with his strong legs to the blossom, and drinking the nectar at his ease. He seems to enjoy it very much. The humming bird gets her share almost as easily. But the strangest part of the story is yet to come.

An Englishman proved by some well-planned experiments that bees love blue. In Europe, where the ruby-throat humming bird does not live, the

columbine is more likely to be blue than red. In America, many of the columbines are a bright and dainty red. In this country ruby-throats are common, and it has been shown that they love red, and are almost sure to seek flowers of that color rather than those of any other hue.

You will find other fertilization plans in the wild flowers of wood and hill and field. The yucca, or Spanish bayonet, that grows on the dry hillsides of southwestern United States, has a story that you will enjoy. It can be fertilized only by a little night moth which enters the flower, not for the sake of nectar, but to find a safe place in which to lay its eggs. It stings one of the seed boxes, and puts an egg in it. As it climbs out of the blossom, it brushes off pollen and carries it to a stigma. The tiny grub, on hatching, eats a few seeds, but so many have been fertilized that the plant can well afford to spare some to feed the little worm.

Make lists of flowers and of the insects that come to visit them. Perhaps you will find out a secret Mother Nature has told no one else, and you may help the whole world by doing so. There are many things yet to learn, and it is only by watching and experimenting that we may discover them. For example, men tried for many years to grow Smyrna figs in California, but the figs would not mature. Finally it was found out that wild figs always grow near Smyrna figs that have fruit. So wild fig trees were at once planted in California—with no better results! Then it was discovered that a tiny insect carries the pollen from the wild trees to the Smyrna trees. So a quantity of these insects were brought to California, and now there is no trouble in getting

a good crop of figs. Which of you will be the first to discover such a useful secret as this?

You have learned enough of fertilization plans to be sure that shape and color and fragrance of flowers all have a meaning. Not one of them just happened by a mere blind chance. Each little petal, each tiny part of the plant, has something important to do with God's work of clothing the fields. How many times have you read in the Bible that *God* clothes the grass of the field? Did you know how minute and careful was his planning for this? Did you know how wonderfully each plan for one flower, one creature, fits into his plans for all the others? If you should ever feel discouraged about your own way or your own work, or what you fear may be going to happen to you, you need only say: "If God so clothe the grass of the field, will he not much more clothe me?" It was of this that Jesus was thinking when he said, "Consider the lilies, how they grow; they toil not, neither do they spin, yet . . . Solomon in all his glory was not arrayed like one of these." Is it not a lovely and delightful lesson of faith and trust in our Father that the flowers have for us?

Something to do:

1. Observe growing corn, and learn its fertilization plan.
2. On what helper do maples depend for fertilization?
3. How does the wild honeysuckle secure fertilization?
4. Find out the fertilization plan of the red clover.
5. Read 1 Peter 1. 22b and Romans 12. 10. Do these verses help you to remember how the flowers and the insects work together to help each other? Would one of the verses make a good motto for your class? Talk

it over with your mates and your teacher. Perhaps you will like to print it in large letters, color it nicely with water color or crayola, and hang it where all may see it.

To learn: I Thessalonians 4. 11; *or* I Corinthians 10. 24.

To read: "Pedigree," a poem by Emily Dickinson; *or* "Two Taverns," by Edward Markham.

LESSON XVIII

FRIENDLY TREES

DID you ever go to a flower show, and see the great vases and baskets of roses or dahlias or chrysanthemums? Perhaps you saw judges walking up and down, talking about the size, color, and shape of the flowers, and finally tying to certain flowers, with red or blue or gold ribbons, cards that held the words, "First Award," "Second Award."

This morning we are going to a great exhibit, and we ourselves are to be the judges. Our specimens will not be brought into a room for us to look at, but each will be left in its own natural place. Nor can we see all of them with our physical eyes; we must sometimes use memory's eye, or the mind's eye, and imagine the specimen to be before us. Perhaps we shall use drawings or pictures to help us a little.

Our exhibit will differ from an ordinary flower show in one other way. Most judges can give the first prize to but one specimen, and there is often disappointment and perhaps hard feelings. In our exhibit we may not all agree, but each of us may make "First Award" exactly as we please, and no one will be treated unfairly, and no one will be hurt. Are you all ready to start? You wish first to know what is to make up the exhibit? What could possibly make a finer one than trees? Get out all the pictures, the drawings, the photo-

graphs, and the descriptions of trees that you can find, and we will begin.

Now, just as the judges in most flower shows look at the flowers in different ways, we will think of our trees in different ways. For instance, a flower may get first prize because it is the largest or the smallest; it may be of any size, but of very perfect form; its color may be unusually fine. For any one of these reasons the coveted first prize may be given.

In the same way, we will think of trees and vote first prize to certain ones as our favorites for different reasons. In the first place, what tree do you like the best of all? How fast the answers come, and how different they are!

Our little Japanese friends vote first for the cherry tree, with its lovely bloom. Our Indian boys and girls think of the birch tree that gives them the graceful and dainty canoe, and, of course, they vote for that. Some of them—and some of us too—think of the sugar maple, and of its gift of sugar, syrup, and candy, and we vote for that lovely tree.

New England boys and girls think of their shady streets and name the graceful elm the queen of all trees, while California boys and girls at once exclaim that the pepper tree, with its fern-like leaves, its drooping branches, and its bright berries, is quite as lovely.

Southerners will vote for the magnolia, or the cypress, or the palm. Boys who depend on the willow for their annual supply of whistles will not forget that tree! Many a farm lad will think first of the white birch that gives him such a splendid

swing, and will quote Robert Frost's lovely poem to show that others agree with him. And what boy will omit the fruit trees—apple, pear, plum, peach, cherry, and a dozen others? Or the nut trees—walnut, beech, butternut, hickory?

Still other children remind us of the evergreen trees—pine, larch, tamarack, fir—and ask what we should ever do without them for Christmas trees. It really is very hard to decide which of all the lovely and useful trees we like the best, when there are so many favorites; and you are very glad that each of you may give as many first prizes as you wish!

Let me ask you to answer another award question. At what season of the year are trees most beautiful? "In the summertime, of course," I hear some of you say. "Trees in summer make big tents of shade. The birds build their nests in them; the breezes play through them all day, and the lovely green of their leaves is so restful and pretty."

"No, no," say other children. "Trees are prettiest in the spring, when the young leaves are just coming out; all the colors are so bright and pretty, and it is then, too, that trees bloom, in pink and white and purple. Spring is the prettiest time for trees."

But the children from New England and Canada protest at once: "No one who ever saw our forests in the autumn will vote for any other season. Our trees flame in yellow and red and browns, in every possible shade. People come for miles to see them then, and talk about the wonder of the sight all their lives."

You are all right, and yet I am going to vote for the prettiest season as winter, when all the leaves have gone, and the delicate tracery of the branches shows up clearly, especially against a sunset sky!

You see, it is just as hard to decide when we love trees best, as it is to decide which one is our favorite.

If we were to attempt to make our awards to the tree that is most useful, we would find this even more difficult, for each is used for many different things and in many ways, according to its character. We have spoken of the fruit and nut trees, that help man by supplying him with food. How long a list of food trees can you make? Where does each grow? See if you can find a picture or make a drawing of each, and tell a little of its help to man. If you can get a leaf and a blossom, and mount them, with the picture, in a book of the stories you write about the trees, you will have a very interesting and worth-while collection in a short time.

But even more important than the food obtained from trees is the wood which they give, of which we make many of the articles necessary to our daily comfort and pleasure. You could fill a book with the list of things made of wood! You might begin with the house in which you live, the school which you attend, the floors on which you walk, the autos in which you ride, the street cars, the poles that hold the wires over which you talk, the table from which you eat, some of the dishes used in preparing your food. Even if your house or your auto is not made entirely of wood, wood

is used in them. And when you begin to count up the small things made of wood—boxes, brush backs, spools for thread, spoons, musical instruments, furniture—to name only the first ones that come to mind—you can see how much we depend on wood for things of everyday use. Suppose that you try not merely to make the list of wooden articles longer but to discover what kind of wood is used to make each article, and why. You will learn a great many interesting stories in this way, and find many facts that will surprise and delight you.

But we have not begun to learn the uses of trees when we have thought of them only as the source of the wood supply. Perhaps the best way for us to discover just what purposes trees do serve is to visit a land where there are no trees; where, through ignorance or accident or greed, the trees have all been cut off, and the land is left quite bare.

We may find a treeless country in many parts of China. Have you not often read or heard of the destructive floods in that country, and wondered why such happenings are so common? It is largely because there are no trees to retain the moisture and let it creep slowly down the slopes; instead it runs off quickly, and floods the valleys, washes away the growing crops and often sweeps away whole villages. Another harm also results, since streams that vary so much as to the amount of water they carry at different seasons are less useful for manufacturing and commerce, as well as for water supply.

You may find in books at the library descriptions of a flood that did much damage when, in

May, 1889, the dam across Conemaugh Lake broke, and a great volume of water swept down through the valley and destroyed the town of Johnstown, Pennsylvania. The flood of waters that caused the dam to give way was partly the result of cutting off the trees on the mountain slopes above the town. When the hot spring suns came, the snows on the slopes were not protected by the trees, and so they melted very fast. The water thus filled the river which ran down with force enough to break the dam, and carry off most of the town.

Trees also serve a great purpose by holding soil on the slopes. As the roots grow and entangle themselves in the soil they bind it and prevent its being washed away. Where forests have been carelessly stripped from the hills, it has sometimes happened that the rich soil deposited in part by the trees themselves, through their falling leaves, soil that it has taken many, many years to make, has been washed away in a few seasons. The result has been that the land has been turned into what is little better than a desert.

On the other hand, where binding grasses have been planted along the seashore or along lake shores where shifting sand dunes are the rule, land has been made through the deposit of still more sand. Then trees have been planted, and they have helped the grasses in their work of holding the soil, till in the course of a few years land that is not only usable, but valuable, has been formed largely through the help of the grasses and the trees.

Have you ever gone into a forest or a small grove and dug up a little of the soil under the trees?

What was it like? Black and fine and rich! Perhaps you carried home a bucket or a basket filled with this rich soil to feed your favorite potted plant. Did you stop to think why the soil was so rich? Yes, it was just because for many years the trees had been casting their leaves on the ground, and these had turned into soil. If you thought to look when you were digging up the fine, black earth, you probably noticed that on the top were the loose, dry leaves; under these were leaves that were partly decayed. Next you found a dark soil, the leaf mold, and I am sure that you found in the layer just below this a soil not quite so dark, but showing plainly that some of the leaf mold had trickled down into it. You were reading a page from the story of the tree's work for the world, and you thought it a very interesting story, as indeed it is!

Of course you have thought of the importance of trees as homes for our other friends and neighbors, birds and beasts of the forest. You know too that trees help, just as plants help, to keep the air pure by taking out of it that gas—carbonic acid gas—that is so harmful to us, and I am sure you will think that all together the trees play such an important part in the general plan of God's wonder world that nothing more is necessary. There is one other work that trees carry so quietly that you may overlook or forget it altogether, and yet it is so useful that you will be glad to know of it.

You remember your experiment to show that leaves take up water, and the other experiment to show that leaves perspire, or throw water out of their pores. You found this true in the case of

all the plants you tried, and so you think it quite safe to say it is true concerning all plants. But compare the amount of such work that all of the plants in a region could do with what might be done by the trees. Remember, too, that the trees send their great roots down below the surface to the waters that lie far beyond the reach of plants, and you can quickly guess that the work of the trees in bringing the water from the earth to the air is very great.

Experiment with a few cuttings in a glass of water. Place beside this glass another in which there are no cuttings, and see how much more rapidly the water disappears from the glass with the cuttings. If a few green sprays can do this, do you not see that land covered with trees will give far more moisture than land covered by water? It has been said that a large elm tree will give off more water vapor in a given time than the largest steam boiler in use, kept constantly boiling for the same length of time.

By this time you are ready to say that trees are among the most beautiful things God ever created. More than that, you think them to be numbered among his most useful gifts. You are not surprised that when the psalmist wished to tell what a good man was like, he compared him to a splendid tree growing by a river, with fruitful boughs and fresh, green leaves, for you can think of no finer thing in the plant world than a great tree. From trees you get many a worth-while lesson. If you are likely to be boastful, you go to Jotham's clever fable of the trees, and decide that you will not be a silly bramble. Or if you are discontented and

think you would rather fill some other place than the one that has been given you, you will remember what the vine and the olive and the fig replied, in the same fable, when the kingship was offered them.

Most of all, you will remember what Jesus said about trees—"each tree is known by its own fruit." A tree in this respect is just like a child—"Even a child maketh himself known by his doings." Since, then, a bad tree cannot bring forth good fruit, is it not very important that we not only plant good trees, but good lives? that we make sure that we are "trees of righteousness, the planting of Jehovah," so that our Father may "be glorified"?

Something to do:

1. Plant a seed of a tree—maple, elm, walnut, or peach. Watch the growth of the plant for a season, and write about it in your book.
2. Plan for an Arbor Day with your group, and plant some trees in a place that needs shade.
3. Read the story of a Chinese boy who tried to keep an Arbor Day; it is called "The Honorable Crimson Tree."
4. Draw a picture or take a photograph of the five most beautiful trees in your community. Arrange these pictures as nicely as you can, together with those that your classmates make. Have an exhibition on Tree Day, and ask all your friends to come and see them. Votes may be cast for the best pictures, and these may be marked with gold stars.
5. Learn to identify all the trees in your neighborhood.

To read: "Trees," a poem by Joyce Kilmer.

To learn: Psalm 1. 3; or Jeremiah 17. 7, 8,

The righteous shall flourish like the palm-tree:

He shall grow like a cedar in Lebanon.

They are planted in the house of Jehovah;

They shall flourish in the courts of our God.

They shall still bring forth fruit in old age;

They shall be full of sap and green.

—Psalm 92. 12-14.

LESSON XIX

FRUIT TREES AND FORESTS

IN our last lesson we talked of the many uses of trees, and came to the conclusion that it would be a sad and dreary world without their shade, their beauty, and their service. But just because trees are so useful, and often because trees have been so plentiful that it has seemed we had many more than we could ever use, man has been careless and wasteful with them. In addition to this, all trees have many enemies that are always ready to harm and destroy them. If we are to keep our beautiful trees, we must learn how to protect them, how to help them fight their enemies, how to use them without needless waste, and how to make certain that other trees shall take the place of those that we cut down.

Inez McFee, in her delightful *Tree Book*, which I hope every one of you will read some day, says, "A tree never dies of old age." She shows why this is true, and then tells of some of the enemies that trees have to fight, and of ways in which boys and girls may help. How many tree enemies have you seen?

Orchard growers in States where snow falls are often much concerned about their young fruit trees, and take care that they shall not be "girdled" when the blanket of snow cuts off the food supply from the field mice. When the mice find their stores running low, or when they wish a change

in diet, they "girdle" the young trees having tender bark; that is, they eat the bark off all around the tree. This generally kills the tree, as the growing layer is either exposed or entirely destroyed. Porcupines may harm forest trees in the same fashion. How may the trees, particularly the orchard trees, be protected? One way is to tie a collar of tar paper closely around each trunk, in the fall. The mice do not like the taste of the tar, and will not eat through it. If it is placed so close to the ground that the little rodents cannot crawl under it, it does the work well. A small orchard may be protected by tramping the snow close down to the tree trunk, but where many trees are to be cared for, this would mean far too much labor.

Far more harmful to trees than rodent enemies are insect enemies. Some eat the leaves of the trees; some bore into its growing tissue and destroy this; others suck the juices that feed the tree. Insect enemies are of many sorts. Each tree is likely to have its own special enemy, an enemy that prefers the juice, the leaves, or the bark of this tree to those of any other in the forest.

You have noticed, perhaps, on the side of a plum or a peach, a little moon-shaped mark, and have wondered what made it. Was it caused, perhaps, by the rubbing of the fruit against some rough bough? No, it was made by an insect that punctured the fruit to lay its egg in a tiny hole, and the slit was made so that the growing fruit should not close up the hole and break the egg. What do you think of that for cleverness and foresight on the part of the insect? Some fruits, when so stung, will fall to the ground in a few days, and in

a short time a whole army of insects will hatch out and be ready shortly to attack the tree.

How often you have noticed, in the trees of the forest, or in the shade trees along the road, a mass of silvery-gray caught in the boughs. Sometimes you have noted many black spots in the mass; at other stages, you have seen that the whole mass was full of wriggling worms, and you knew that something must be done very quickly or the poor tree would soon have no leaves left on its branches at all. Perhaps you called the attention of some grown-up to the matter, and you helped them soak old rags in oil, and then watched while they burned the nest out before the insects could spoil your tree. This might be possible where you had but a few trees to treat, but could not be carried on to any great extent; and, besides, it is likely to injure the tree almost as much as the worms themselves.

One enemy much dreaded by orchard owners is called the San José scale. It is a very tiny creature that you might think too small to be of any account at all, but, like most insects, it multiplies with remarkable rapidity, and does a vast amount of damage. Once let a single family get started, and it will not take long to destroy a whole orchard.

Frequently you may find on oaks and willows little red-cheeked apples. At least you think at the first they are apples, and perhaps at the second look. Then you ask if old Mother Nature is playing a trick on you, and you examine one of these "apples." If you cut it open, you will find a tiny grub on the inside. An insect has laid its egg months before on a leaf, which formed presently into the "apple," or gall, as it is called. At the

right season, the egg hatched into the larva, which in due time would have eaten its way out had you not cut open the gall. Galls of different sorts, and made by different insects, are found on different trees; and, of course, all are more or less harmful to the tree.

There is still another kind of enemy that attacks trees, that is known as *fungus*. Fungi are low forms of vegetable life; they never make their own leaf green, or chlorophyll, but must steal it. So they fasten themselves to trees in many different ways. Sometimes they attack the roots; other times they enter through breaks in the bark, or through wounds that have been caused by wind or fire or animal. Fungi are of many sorts and show themselves in many ways.

Have you ever found an apple that was marred by rusty spots? These were made by a fungus that attacks apples and spreads with great rapidity. Another fungus sometimes attacks the leaves of apple trees. Still another lives on pine trees, and makes them quite useless for lumber, and soon kills the tree. One such fungus needs the wild currant or wild gooseberry bush to complete its life circle, and the only way to save the pine trees is to pull up these bushes. This would not be a great task in a small wood lot, but what can the owner of a lot containing many acres do?

Here is one place where the government steps in to help owners fight tree enemies. From State or national headquarters, experts are sent out, with a crew of helpers, perhaps five or six in number, and these men proceed to search every foot of the lot and to make absolutely certain that all

bushes that will help the fungus to live are pulled up and destroyed.

It is an interesting sight to see the men at such work. Beginning at one corner, they walk along a side of the lot to the opposite edge, each man at arm's length from the next man, and a young boy on the very outside. As a man finds a bush, he pulls it up. The boy carries, slung over his shoulder—you never would guess what he carries!—a bag full of scraps of torn paper! Every few feet, as they advance he sticks a bit of paper on the end of bush or twig. Then when the row of workers reaches the side of the lot, and are ready to turn back, they follow the little scraps, as a guide to make sure they are not skipping any part of the lot in their search for bushes that may serve as the host for the destructive fungus.

This is only one way in which the government helps to save the trees by fighting their enemies. Some States have spent millions of dollars in fighting a single pest. The national government keeps up four well-equipped stations through which all new plants that are being brought into this country must pass, in order to make sure that they will become good plant citizens. Watch is constantly being kept on fruits and other vegetable products of foreign countries to make sure that no harmful enemy is coming in along with them. Ask your teacher or your librarian to find out why lemons and grapes from Italy were recently shut out. Study the trees of your own section, and if you discover they have enemies that are harming them, write to the Bureau of Agriculture or to the Forest Service in Washington, D. C., for directions as

to how you may help, for this is another way in which the government is working. Wise men study the tree enemies and how to get rid of them. They write clear and simple accounts of what they find out, and the government prints these. Then, people who wish to drive out these harmful insects and other enemies may have the printed matter for the asking. There is much that wide-awake boys and girls may do to help in keeping down or destroying many of the tree enemies, and in thus playing the part of good American citizens. Watch for the way in which you can do so most surely, and you will have an interesting and happy time in it all.

Perhaps you are beginning to wonder how trees ever get a start, or how it happens that we ever have a forest when there are so many enemies that work against the trees. You may wonder still more when I tell that the most powerful and the most dreaded enemy of the forest is not an insect army, but fire. Every year fire destroys many trees, or injures them so much that they are not only quite useless but become a positive danger. More than this, the fire kills the young trees that might grow into a new forest, if the old trees were merely cut out and carried away. The fire, too, burns up the forest floor covering, exposes the soil to the washing away effect of the rains, and spreads ruin and desolation wherever it goes.

How do such destructive forest fires get started? Some of them undoubtedly are set by lightning. Many more are set by careless campers or picnickers. A few are set deliberately by men who wish to clear the ground for grazing, or to make prospecting easier.

In the forested regions of our country the government now keeps up a forest care or survey, and the forest rangers, during the dry season particularly, are on the watch for fire. If, from their lookouts, they discover smoke or other signs of a fire, they signal for help, and start a vigorous fight against the fire. This often results in great saving of trees and money; the life and work of a forest ranger are full of interest and excitement,



(By Arthur Newton Pack. By permission of *Nature Magazine*, July, 1923)

HOW MANY FIRES ARE STARTED

and you will enjoy reading about them in books that you may get from the library.

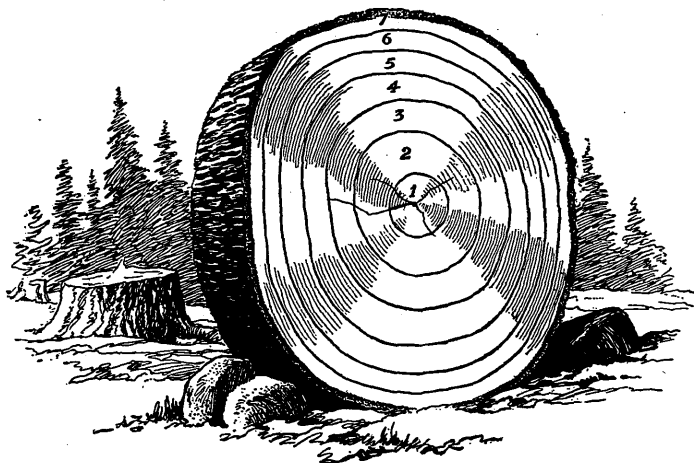
Boys and girls are not likely to be called on to fight a forest fire, but there is scarcely one who may not do something better than fighting a fire—each may help to prevent a fire. When you make a camp fire, be sure it is a small one, in a cleared space, where no dead or dry leaves will permit it to spread. Most of all, when you have finished with it, be sure it is out, thoroughly out, before you leave the place. If you can pour a few buckets of water over the embers, it will give you a comfortable feeling of safety every time you think of it after you have gone!

There is still another way in which boys and girls may help, and this is such a delightful way that I am sure you will all be ready to start at once. Of course you know that I am thinking of planting trees. You do this in school on Arbor Day, but you do not need to wait for this special day to come once a year; you may keep your own Arbor Day whenever you wish. Find out what trees grow best in your vicinity; talk it over in your class, with your mates, your teachers, your parents. Lay plans for a beautiful, tree-lined town, and then make a start as soon as you can. Some trees grow quite well from seeds. In California it does not take long for the toyon, the beautiful California holly, to grow from seed into a good-sized tree; and there is this added pleasure in having one on your street, or in your yard—birds love its red berries and will come in numbers to feast on them as soon as the tree is old enough to bear.

Would you not like to ride along a road on either side of which fine nut or fruit trees grew, with their silent invitations to eat of their good things? Why would it not be a good idea to plant such trees, for shade, for beauty, and for use, along our highways? Perhaps you can start the fashion in your town, and I am sure many people will follow it.

There are so many points of interest about trees that whole books might be written and still all the story would not be told. But you will wish to know that trees themselves write stories, and many men have read them. In a little book by Mr. Mills you will find the fascinating tale of how he read the life history of a pine that had lived for more than a thousand years. To tell the story

here would spoil it for you, but you can imagine how the tree told its story, though there was more than one surprise in it, even for one who knew trees as well as did Mr. Mills. Try reading a tree's history yourself some day. If you can go into the woods, you may be able to find the stump of



If this section of tree in Yosemite Park could speak it could tell of historical events for nearly a thousand years.

1. A. D. 923.
2. 1066 Battle of Hastings.
3. 1215 Magna Charta.
4. 1492 Discovery of America.

5. 1620 Landing of the Pilgrims.
6. 1776 Declaration of Independence.
7. 1860 Civil War.

a tree that has been cut but a short time. If you live in a town, perhaps you can visit a sawmill, and look at some of the logs that have been brought there to be cut into boards. You will see at once that the log looks as if it were made up of rings. Count them. Forty, fifty, perhaps as many as a hundred. The tree has told you its age—one ring for every year. Perhaps the first rings are very

close together. This may mean that the little tree had poor food. Here is a check or crack. Perhaps a very cold winter made this, when the frost cracked the tree at this point. Here the circles are wider. There was a season with plenty of rain. The rings on one side are wider. Probably the trees that grew near were cut away from this side, and our tree was able to get more sunshine. The later rings may be much wider; our tree had grown large and strong; it lifted its head far above the others into the sun and air; it sent down roots deep into the earth and brought up plenty of food and water, and so made sturdy growth. Do you not think it will be fascinating work to read the life history of a tree? How little that tree knew that it was building into its very fiber the story of what it was enduring and just how it was growing. This is like our own lives, as we go on from day to day, busy with work and play, with study and fun. We do not think much about what we are writing into our book of life—perhaps we think altogether too little. But some day it will be quite finished, that writing; our work will be done. You look at the tree, ready for its service to man, and you say, "What a noble tree!" So will people say of you, "What a noble life!" if you follow God's plan for your life, as the tree followed God's plan for its life, if you do, as did the tree, and make the best of the place where God has put you.

Something to do:

1. Write two things that boys and girls may do to help preserve our forests.

2. Write a short story about the work of the forest rangers.

3. Find out what trees are spoken of most often in the Bible, and tell where they were found.

4. Where are the oldest trees on the earth to-day to be found? How old are they supposed to be?

5. Try to get a section of a tree, and study the rings. Imagine that you are the tree, and tell your story to the class.

6. Write to the United States Forest Service for instructions about keeping your trees free of insect pests, and then follow directions.

7. How do "our feathered guardians" help in fighting tree enemies? What ones are the best helpers? How do they help?

8. Look in the Bible for stories of trees, and make a Bible Tree Book.

To learn: Matthew 7. 17-20.

**The trees of Jehovah are filled *with moisture*,
The cedars of Lebanon, which he hath planted;
Where the birds make their nests.**

—Psalm 104. 16, 17a.

LESSON XX

SEED HOMES

YOU have learned how leaf, stem, and root of the plant all work together for the one purpose, that of making good, strong seeds, not for the sake of the seeds, but that new plants may be had from season to season. You have learned what is perhaps the most wonderful story in all God's great wonder world—the story of the mingling of two bits of life substance, that of the pollen, and that of the tiny ovule or seed in the seed box, from which grows the new seed. Perhaps you think the wonder story is all told, but I am sure you will find it interesting to study for a short time the kind of homes in which the little seeds grow.

You have seen your mother line a soft basket, a cradle, or a baby carriage, with blankets and pillows for baby brother or baby sister, and you have watched this little child grow, and grow rather fast, till the basket or carriage was quite too small. And, of course, you know how very soon a baby grows too big for the little clothes that fit so well in the beginning. As for yourself, you can hardly watch yourself grow, but if you will try to put on a dress or a hat or a pair of shoes that you wore last year, you will find it quite impossible. You probably know that mother is kept busy getting new clothes ready for you to wear because you outgrow your old ones so fast! That is just what healthy boys and girls are expected

to do—to grow so well and so fast that no clothes fit them for a very long time.

Healthy seeds are much like healthy boys and girls—they grow very fast indeed. But they are not like boys and girls in this way: they do not put aside old clothes for new, and they stay in their cradles till they are quite grown up and ready to take care of themselves! Imagine boys and girls staying in a cradle or a baby carriage till they were grown into men and women! You say you think they would be pretty poor men and women, and you are right. This is another way in which seeds are not like boys and girls, for they would have little chance of growing into strong seeds if they left their cradles before they were quite grown up.

How do seeds get new clothes, if they continue to grow? By the simplest arrangement in the world! Their clothes grow with them! Wouldn't it be fun if your coats and your shoes and your dresses should grow just as fast as you do, and keep new and fresh all the time? Better than that, wouldn't it be fine if your cradle or your house just fitted your needs from the time you were a tiny baby till you were ready to take your own part in the world? Do you not agree that seed clothes and seed boxes are wonderful?

Let us look at some of these seed homes. Suppose you plant a common white bean in the moist ground. Presently, after a few days of sunshine, you will see two fat little leaves coming up through the ground, and you may be inclined to say at first that the whole bean has come up. I have even known children who did not understand what

was going on to put these two fat beanlike leaves under the ground again! But I am sure you know that in the moist earth the bean swelled till the tough outside skin burst, and then the fat leaves pushed up, and will feed the baby plant till the tiny roots have had a chance to get a good start. Then the leaves that come next will be of a different shape. They will come one after another till you have a good-sized plant, and some morning when you go to look at it you will find that it has bloomed. How eagerly you will watch, and how you will wish for very fine eyes to see the dusting of the pollen on the sticky stigma tops! You can hardly hope to see what is going on, but you will know that the fertilization has taken place when you see the pretty petals beginning to wither and drop. Then you will note that the cradle of the baby seeds is taking shape. What a queer cradle it is! Long and narrow and green! But every day it grows wider and thicker and longer. Presently you can feel, by running your fingers down both sides of the green cradle, the baby seeds that are tucked on the inside. You will see how very firmly the cradle is tied to the mother plant. If you break off a "pod," as we have come to call cradles of this sort, and if you split it down on one side and open it, you will see that each little seed, which is green like the cradle at first, seems to be tied to the cradle too. Do you suppose this is to keep it from falling out? Not at all! It is through this little tie that the baby seed gets its food from the mother plant. You must remember that the roots are pushing through the ground in search of water, and foods of one sort and another; that

all these juices are being pumped up to the leaves to be cooked in the sunshine, and that they are being sent to the seeds to help them to grow. Even the thick walls of the cradle are to help feed these hungry little plant children in their snug cradle.

As the days go on, the seeds grow larger and larger. The cradle walls grow thinner. The color changes from green to yellow. After a time, the little string-like fastening that held the seed in its place in the cradle dries, and may disappear entirely. The seed is grown. It needs no more food. It is ready to start all over again, as soon as it leaves its home. How it leaves home is another story, and we will keep that for next time.

For another seed-home story, go to the tomato; plant the seeds and wait for them to sprout. First come up two long narrow straplike leaves, cunningly folded in the little brown cap of the seed. If you know the rough and very much cut leaves of the tomato, you will never guess that these two straight leaves belong at all. Like the first bean leaves, they are for food for the baby plant. When the tender little rootlets have made a start, and the next leaves grow from the stem, you will find them to be true tomato plant leaves. They grow very fast, and after a time you see small yellow blossoms on the plant. Again the wonderful story of fertilization is carried out, and you will go to your garden some fine morning to discover your plant has several green, ribbed balls where the yellow blossoms had been a day or two before. These are baby tomatoes. As the plant drinks in food and sends it to the growing tomatoes, these grow too. Presently they begin to change

color, and after spending a few short weeks on the mother plant in the warm sunshine, they become a brilliant red, and you say the tomatoes are ripe! You cut them and take them to the kitchen to be made into a delicious salad or a soup. Do you ever stop to think that the tomato is just a juicy cradle, not for one seed, but for many? If you had cut a green tomato, you might have seen on its walls the tiny baby seeds, wearing, as seems quite proper for babies, nice little white dresses. As the tomato ripened, the seeds grew, and their dresses grew at the same time. Like the beans, the seeds were attached to the cradle walls by tiny fastenings through which the food that was to make them grow was sent to them. When such a connection is no longer needed, it disappears almost or quite entirely, so that you may never have noticed it in the ripe tomato, but you will be interested in looking for it in the green fruit.

Another garden cradle holds the baby seeds in quite a different fashion. You might say that each seed stands on its one toe, and this plant not only has many cradles, but every cradle cares for dozens and dozens of children. The plant is a regular Old Woman-who-lived-in-a-shoe among the plants! But she knows exactly what to do! She too has a cradle that grows as the babies grow. She arranges the children in nice, orderly rows and wraps the entire cradle around with a fine fiber as soft as satin. Layer after layer of this covers the babies, each layer being a bit tougher and coarser than the one just below it. As the baby seeds grow, the covers grow and stretch, till the mother plant knows that the babies are

almost ready to look after themselves. Then the covers stop growing, and begin to turn from a lovely silvery green to a soft yellow. They would become a golden yellow if they were allowed to stay with the mother plant till they were quite ripe, but some morning the gardener goes up and down among the plants, or father takes a look at them, and says: "The green corn is ready to cut!" How you do enjoy the sweet, juicy ears! But you lay the cradle itself aside; you think that is only the *cob*! Next time, stop long enough to find the places on it where the babies tucked their toes in, and sent down from each toe the wee tube through which the food juices came to the growing baby. If they had not done so, you would have had no corn for dinner. What is of far greater importance from the plant's point of view, there would have been no seeds.

There is a very common garden plant of which you have all eaten, and I am sure many of you have seen its blossom, but it is quite probable that you have never seen its seed. Perhaps you will like to watch for them when next you grow a garden. You know that when we wish to raise a crop of potatoes we cut the potatoes, taking care to leave on each piece an "eye," or one of the little scars that mark potatoes. From each eye will come a root, and when the plant is well grown, you may have noticed the very pretty white blossoms. Many times these blossoms do just what blossoms are supposed to do—they produce seed. But we seldom think of the seed cases, or "potato balls," as they are sometimes called, for the crop of potatoes in the ground is what we care for most. Yet all

new varieties of potatoes come from the seeds, and it is interesting to plant them and then watch to see what sort of potatoes will come from seed. For, strange as it may seem, there is no certainty that potato plants grown from seed will be like the mother plant, or, for that matter, like each other! Perhaps some boy or girl who hears this story of seed homes will keep sharp lookout for a potato ball, plant the seeds, and get a new kind of potato that will be as famous as the Burbank or the Early Rose. That would be worth while, would it not?

There are many more seed-home stories from the garden than I can begin to tell. Besides, you wish the fun of finding out some of them for yourselves, do you not? And when you have learned all there are in the garden, go to the trees. Discover the twin cradles the maple makes for her babies, and compare them with the queer little cradle of the elm tree. Find some of the shiny brown cradles of the oak, each snugly fitted into a cunning round cap that holds the cradle to the twig until the seed baby is well grown.

Then you will wish to tell someone the fairy story of a wee white seed that wears a dress of finest brown leather, which is as smooth as satin. The ripe brown seeds are packed in cells, five in all, whose walls are made of a thick tough material. Outside of the cells, which are arranged in a pretty star pattern, is a white juicy substance two, three, or more inches thick, and covering this is another layer of satin, red, yellow, or green as it may happen. If anyone finds it hard to believe your fairy tale, cut a ripe apple across the center and show him the star-shaped core and the brown seeds lying inside!

The trees that bear cones will have a long and fascinating story to tell. The pines, the firs, the spruces, and others, each has its own pattern of cradle, and each its own way of caring for the baby seeds. See how many of them you can discover for yourself.

As for trees that give us nuts good for food, there is no end to the interesting cradles to be found among them. You can find out for yourselves about the walnut, the pecan, the filbert, the beech-nut, the chestnut, and the butternut. You may think the cradle in which the Brazil nut lives is the oddest of all and I must tell you about that. Did you ever wonder how the queer, three-cornered little brown nuts grow on the trees? Did they ever make you think of the sections of an orange? Perhaps you will not be surprised to learn that each single nut, as you buy them in market, does not grow all alone on the tree, but that many of them are crowded close together, much like the parts of an orange, and all are covered over with a strong outer case. In this they rock and swing in sun and wind till the seeds are fully grown. Then—down comes the cradle, babies and all! The outer shell breaks with the fall, or is broken open by nut gatherers, or by hungry monkeys. But while monkeys may easily break open the outer shell, it is far harder to crack the three-cornered single shells, as the sharp edges are unpleasant. Do you not suppose that is just a part of the plan to save all the seeds from being destroyed and to make sure that new plants will come? You will feel quite certain, I think, that the queer shapes did not come by mere chance. There is

a wisdom back of the Brazil nut's plan, and back of the plan of every seed home, such a wisdom that we think it must have been a part of our heavenly Father's thought for his world and the creatures that live in it. It is easy to think of God when we look at the great works he has done, the sun and the stars, the sea, the clouds, great mountains, and the mighty rivers. But we can learn of him just as truly through learning his plans for the wee things of life, the things that we accept as a matter of course. Let us remember that he has chosen the weak things of life to confound those that are mighty, and that in wisdom has he made them all. Let us see his loving care in the wonderful seed homes that he has provided, and in this way we shall get one more glimpse of his great wisdom and power.

Something to do:

1. Make a collection of seed homes—pods, sails, pits, nuts, and other kinds. See how prettily you can arrange your collection, and how many new facts you can learn by yourself about seed homes.
2. Find out why nuts have hard shells.
3. Discover what sort of seed homes the strawberry, the red raspberry, and the currant have.
4. Examine the seed of the pin cherry, and tell what it is like.
5. Imagine you are a chestnut, and write the story of your life.
6. Describe the rose seed home.

To learn: Matthew 13. 31, 32.

While the earth remaineth, seedtime and harvest . . . shall not cease.—Genesis 8. 22.

LESSON XXI

HOW SEEDS FIND NEW HOMES

As you have studied the life of different plants, and have found how the plant works to make strong new seeds, to feed them, to care for them in snug and comfortable cradles till they are able to look after themselves, perhaps you have decided that the plant's work was finished when the seeds were ripe. Good seed, well ripened, is most surely the chief aim of the growing plant, but many of them act as if they were not entirely satisfied when this is accomplished; they try to finish up the task by helping their seed children find a new home.

Does this seem very strange to you? Do you wonder why seeds need a home other than that of the mother plant? And, most of all, do you wonder how a plant that is rooted fast in the earth can possibly help her seed children travel to a new place to live? Let us see if we can find the answers to any of these questions.

First, why should seeds need a new home? Suppose that all seeds, as they ripened, fell around the mother plant. What would happen? The mother plant has been taking the food from the earth to feed her growing children, and so the ground cannot be as rich as it once was; the food for new plants would not be as good. Besides, if all the seeds fell together on the ground, some would choke out the others, even if



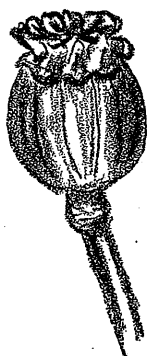
Acorn Seed

they found room to begin a growth. The mother plant would often be so tall and strong that her leaves would cut off the sun from the baby plants, and then they would soon die. So you can see that it is quite important that some way should be found to start the seeds growing in a new home. How can the plant help in this?

Let us go back to the bean plant that we talked of in our last lesson. As you are a careful gardener, and have raised the beans for your table, you have probably always gathered them a little before they were "dead ripe"; that is, a little before they were so ripe that the mother plant was sending them off to find a new place in which to start. If you leave a bean or two on the vine and watch to see what will happen, you will some day dis-



Palestine Anemone

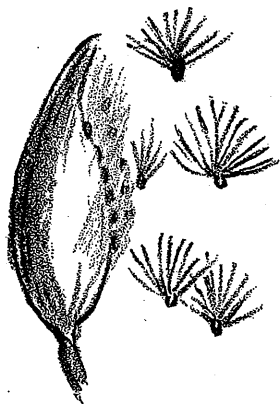


Poppy Seed Jumper

cover that the pod has divided; the two halves have separated, and each hangs, dry and twisted, from the stem. The beans are no longer fastened to the pod. If you look for them, you may find them lying at some little distance from the

plant. What has happened? The bean pod, when it dried, twisted so strongly and sharply that it shot the beans out of their comfortable cradle, and sent them flying a little distance away, and so each little seed has a somewhat better chance of getting its start in life. Peas send their seeds out into the world in much the same way. We might call them shooters, as they shoot their seeds out of the pods.

Ask your librarian to help you find a description of another shooter that Henry Thoreau describes, the witch hazel. It shoots its seeds, or nuts, much farther than does the bean or the pea, and Mr.



Milkweed Seed Flying Away



Dandelion Seed



Thistle Seed
Showing parachutes

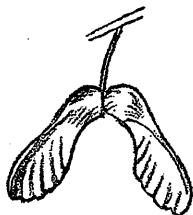
SEEDS—HOW THEY TRAVEL AND WHY

Thoreau tells in a very interesting fashion of hearing the little nuts drop on the floor during the night, and of finding out what made the noise that puzzled him so much at first. Can you find any other shooters?

Some plants make air sailors of their seeds,

and provide them sails and parachutes. The milkweed, the cottonwood tree, dandelion, the thistle, are among the air sailors, and you will have an interesting time in finding out for yourself just how the flying machines of each kind of seed differ from the others.

In the early summer you have often noticed the fruits of the maple tree hanging in clusters from the tree. Perhaps you have called them "maple keys," as many people do. It would be more correct to call them "maple sails," would it not? For, if you watch till the seeds are quite ripe in their twin cradles, some breezy day, you will see them go sailing off on the wind to



Winged Maple Seed

find a new home. The elm tree and the ash have sailor children too, and you will be glad to hunt for them, and to draw their pictures in your notebook. How many other sailors can you find among the seeds?

It is quite likely that you have never seen a plant sending its children off to take a real water sailing trip, but you have seen and probably eaten the fruit of the coconut. Many of these trees grow quite close to the edge of the sea, and when the fruit is ripe it may fall and bounce and roll till it gets into the water. Then the wind and the waves may carry it for a long distance, finally washing it up on some shore far away from the one where it began life. There it sends down its shoots, and after a time a new coconut palm has



Winged
Elm Seed

begun to take root, and grows, till it in turn sends out its children.

Some plants use quite a different plan in sending away their children. They wrap the seeds up in the most attractive packages that fairly cry, "Take me, take me!"

Have you never seen such a seed package? Why, certainly! Apples, pears, peaches, plums, apricots, oranges, and many more, belong in this list. You and your friends eat the sweet and luscious pulp that sur-



Coconut Seed
Showing Husk



Husk cut away
showing nut

rounds the seed, and you seldom eat it under the tree on which it grew. This means that you are quite likely to throw the seed down in some spot far away from the parent plant, where it will have a better chance to grow. Perhaps you think the peach is a native American, but it really came in the first place from far-off Persia, and was carried so far, and has found so many new homes, almost entirely because its seed package has been so attractive to men and women, boys and girls.

But notice another part of the plan—it is only the sweet and juicy pulp that you eat. The seed itself is shut in a hard and often a very tough case that you do not like at all, and that you carefully avoid eating. The brown case of the apple seed has an unpleasant taste. The pit of the peach has a bitter oil that keeps it from being eaten, and when the tender pulp has been used, you throw the true seed aside.

Some plants extend their invitations, not to men and women, but to birds, and get a better chance for a good start for their seeds in this way. One kind of cedar shuts its seeds in bright-red berries that attract the attention of the birds, who feed upon them, carrying them away in their crops. The seed itself is in a very hard shell that is not ground up with the rest of the food, and so cannot be digested, but is dropped by the birds, and the new plant begins its life, perhaps miles from the parent plant. The mistletoe, a plant that lives and grows on oaks, has a sticky material as a covering. When the birds eat the ripe berries, they try to remove this from their bills after a meal, and so they often help to plant the seeds on another oak bough, the sticky material helping to hold them in place till they have had time to send down the roots that pierce the bark and suck the oak juices.

Some plants get the help of the birds in another way. The birds may alight in wet places and get bits of mud caught on their feet. This mud may contain many seeds; or perhaps the bird may again alight on a weed or tree where the seeds are ready to go, and these will get caught in the mud on the bird's foot. This mud may dry and stick to the foot for a long time, and the seeds may finally be planted miles away from their first home. A great English student once raised over eighty plants from seeds that he found in the bit of mud that he took from the foot of a bird.

I suppose you might call these seeds travelers, paying passengers, for at least those that have a pulpy covering that is good for birds to eat have

paid their way. But there is a large class of seeds that we shall have to call tramps. They steal rides whenever and wherever they can. Perhaps this is because they never could get anyone to give them a ride! Have you ever gone for a walk in the autumn and come back with your coat well covered with some of these little tramps? You may call them burs, or stick-tights. Some of them have hooks, and some have barbs, while others have teeth with which to hang to our dresses, to the



Bur Tramp Seed

Bur Bract
(Enlarged)

wool of a passing sheep, or the tail or the thick coat of your dog, or the manes and tails of animals. Of course, as soon as we can get the chance, we pick off these unpleasant things and fling them on the ground, and we have done exactly the best thing for them—we have given them a place for a new home. Be on the watch for these fellows, and see how long a list of seed tramps you can make.

Sometimes seed tramps are really quite terrible. There is an African plant that has a way of fastening itself so firmly into the hair of animals that it is said a lion will kill himself in his efforts to tear the seed case from his skin. Another ugly customer has made its way into California through



Photograph by Maude A. Jumper, Shafter, California.

Shafter, Kern Company

BOY SCOUT—TROOP NO. 1

One of the boys who helped to free the California roadways of the troublesome puncture weed

a cargo of goods from a foreign country. Each little seed has two very sharp and tough points, about as big as a common carpet tack. They are so arranged that no matter how the seed falls, one of these points is always up. The points are so tough that passing automobiles do not break them. Quite the contrary! The point buries itself in the rubber of the tire, and the seed is carried off. In this way the dreadful plant has been widely spread, and measures are now necessary to control it and to banish it from the highways.

For a happier story of seeds seeking a new home, you must read a delightful book by E. A. Mills, *Rocky Mountain Wonderland*. He tells of watching a forest fire one day, and of seeing, before the smoke had died down, brown-winged seeds fluttering from the top of a burned tree. The lodge pole pines have cones in which the seeds are sealed by a sort of gum or wax. This had been melted by the heat, so that the shut-in seeds were set free, and came fluttering down to sow the burned-over ground at the very first chance.

Do you not agree that it is a wonderful thing that the fire that destroys the lodge pole pines is exactly what is needed to sow the burned-over ground with new seeds? But the perfect fitting of the plan does not end there. Can you imagine what sort of soil the little seeds like to grow in? A soil that is cleared of other growth, and fertilized by ashes!

Our human way of seeing things does not always let us know quite so surely how the parts of God's plans fit so wonderfully into one another, but it helps very much to see this in even one single



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Our human way of seeing things does not always let us know quite so surely how the parts of God's plans fit so wonderfully into one another, but it helps very much to see this in even one single

case. We surely agree that the lives of boys and girls are of much worth to the heavenly Father. If he so carefully plans for the plant life, how much more carefully must he plan for human life! Ought we not to take heed to the finding out of these plans? Then, like the tiny seeds, we must throw down deep roots, send up strong plants, and bring forth the best of fruit. Do you remember what Jesus said about this? "Herein is my Father glorified, that ye bear much fruit." "Apart from me ye can do nothing."

You do not need to be told that the fruit of which Jesus is speaking is what the Bible calls the "fruits of the spirit." If this seems hard for you to understand, remember that even a child is known by his doings. Do you think that cheating in games or failing to play fair is a good fruit? Or would you rather have a friend who is always cheerful and helpful? Do you like your chum to share with you? What other good fruits can you remember?

Something to do:

1. Make a collection of seeds that travel because they send out invitations for rides.
2. Tell your mother a story of the "tramp seeds."
3. Find a Bible story about seeds and learn to tell it.
4. Find how the squirrels and chipmunks may help seeds to get new homes.
5. Are the wild flowers in your community being destroyed? Find out about it; discuss it with your teacher and your classmates, and see if there is anything you can do to help in the matter.
6. Help some seeds to find new homes by planting those that will grow easily in some place where they

will give pleasure by hiding an ugly fence or a bare bank.

7. Think of the boy or of the girl you like best to play with. Why do you like this playfellow? Think of things you do not like in yourself. For example, quarreling, frowning, getting cross, wanting the best of things for yourself. Perhaps it will help you to rule a sheet of paper with a line running down the middle of it.

At the top of one column you might print or draw a thistle, and under this you may write the names of some of the "thistle deeds," such as being selfish about the best seat, the largest bit of candy, or something of the sort. When you have pulled that thistle out of your heart garden rub out the name on the paper!

At the top of the second column, write "Good Fruit." Perhaps you will make this pretty with a picture. Under this write all the kind and helpful deeds you see your mates doing for a week. What a long, long list you will have!

To learn: Genesis 1. 11, 12.

In the morning sow thy seed, and in the evening withhold not thy hand; for thou knowest not which shall prosper, whether this or that, or whether they both shall be alike good.—Ecclesiastes 11. 6.

LESSON XXII

OUR DAILY BREAD

"COME, Don! Come, father!" called Ruth.
"Dinner is ready, and I have the loveliest surprise!"

Don followed his father into the dining room, his bright eyes searching for the surprise. But he said not a word at first. He sang with the others the old Jerusalem grace, beginning

"God is great, and God is good,
And we thank him for this food."

But as soon as he was seated, he broke out with,
"I don't see any surprise!"

Then mother lifted a snowy napkin from the bread tray, and with a proud smile disclosed a loaf of fresh bread. What a brown crusty top it had, and how good it smelled!

"Ruth's first loaf of bread!" she said.

"I made it all by myself!" said Ruth.

Don could scarcely wait till Ruth had received father's praise for her work before he began slyly, "But you just couldn't make a loaf of bread all by yourself, Ruth."

"Why, Don Harris! I did indeed make it all alone. Mother never touched it!" she said with some indignation.

As Don continued to shake his head, his eyes dancing with fun, she went on:

"I measured the milk and the water and the

yeast and the salt and the flour, and put them all in the mixer—”

“And what about the flour?” demanded Don. “I have not forgotten my primary teaching, if you have, Miss Ruth! ‘Back of the loaf the flour, and back of the flour the grain’; don’t you remember?”

“‘And back of the grain—’; yes, I know what you mean now, Don. I hadn’t thought of it before,” said Ruth.

“It’s splendid bread,” said father, helping himself to a piece; “I’m glad you made such a big loaf; I’m glad too that you did not ask all the persons who helped make it to come for dinner, for I suspect there would be so many that there would not be a crumb apiece for them.”

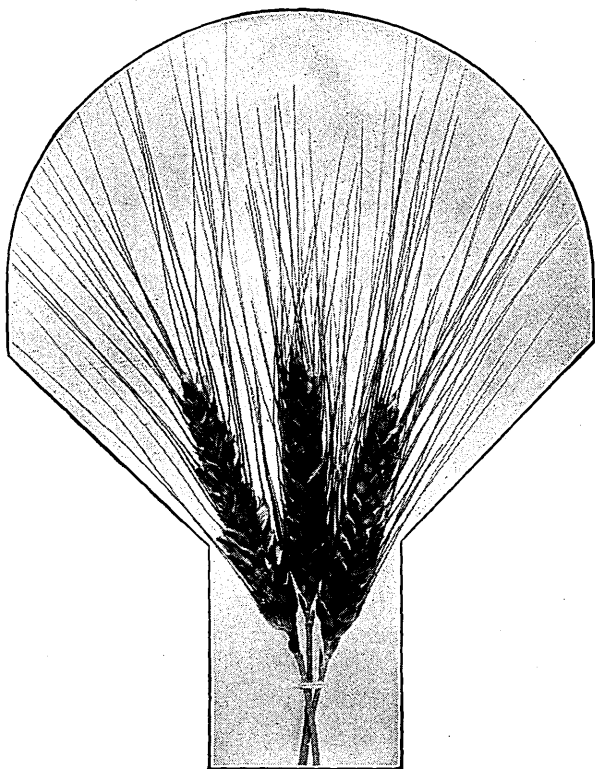
“You’d have to begin with the errand boy who brought the bag of flour to the kitchen door; then there would be the grocer who keeps the store, and his clerk who ordered the flour, and all the men that ran the train on which it came to the town, and the workmen who made the railroad—” Don was thoroughly enjoying himself as he gave free rein to his imagination.

Ruth laughed as she pictured all these helpers crowding into the dining room to share with her her first loaf of bread.

“They all helped,” she admitted, “but I’d rather share it with those who helped the most—the people who raised the grain, and those who turned the grain into flour. Who do you suppose they were, father, and just where did our loaf come from?”

“Perhaps the grain came from California or Kansas or Minnesota; it may have come from any

of our great wheat-growing States. It may have been raised in Canada; if the crop there was poor,



United States Department of Agriculture
(By permission of *Nature Magazine*, July, 1924)

WHEAT, THE KING OF CEREALS

it may have come from Europe or South America," said father.

"But with all the land we have, we are pretty apt to grow in the United States what grain we

need for ourselves, and much more too, aren't we, father?" asked Don.

"Yes, generally," agreed father. "I was merely thinking of a statement that I read the other day that the harvest could be followed around the world, month by month. We Americans are the greatest wheat-eaters in the world, and we naturally produce the most wheat."

"Do you remember the Englishman who visited the United States when it was the fashion for men to wear whiskers on the chin, and what he said about us?" asked mother. "He wrote that 'Americans eat so much wheat that the spears, or blades, or whatever you call them, grow out under their chins.'"

Don and Ruth laughed merrily at this funny picture, and Don asked:

"How much wheat do we actually eat every year, mother?"

"Two hundred and fifty loaves of bread for every man, woman and child," answered mother, promptly. "Father will tell you how many bushels of wheat that means."

"Two hundred and fifty loaves!" gasped Ruth in surprise. "That means I shall have to make a thousand loaves for just our family. How much wheat will that be, father?"

"You can make just about two hundred and fifty loaves of bread from one barrel of flour," replied father. "It requires five bushels of wheat to make a barrel of flour, and this is just about the average amount of wheat eaten by every person in the United States in a year."

"Some work ahead of you, if you are to use four

barrels of flour, and make a thousand loaves of bread, you see," grinned Don at his sister. "But, father, tell us more of the fellows who helped Ruth make her first loaf."

"We must count, of course, the men who plowed and sowed the wheat fields," said father. "Of course this is mostly done now by tractors, but when I was a boy such means had not yet been thought out. I lived on a farm of two hundred acres, and I plowed many a field, with two strong horses to drag a steel plow. We thought a great advance had been made after the vast prairie farms came under cultivation, and two, four, or six teams were used on the plows."

"It was a wonderful sight to see plow after plow following one another around a big field, turning up the rich earth," said mother.

"It was, indeed," agreed father, "but the tractors are both cheaper and easier, and this makes it possible for even the poor people in America to have good wheat bread on their tables every day, in place of the black bread which many living in lands less favored than ours must use."

"I'd like to see a field of ripe wheat, with the wind blowing across it," said Don.

"It makes a great picture," said father, "but one that I like better is the cutting of the wheat. Many an acre I have cut when I was a little younger."

"With a reaping machine, I suppose?" asked Don.

"Yes," answered father, "though my grandfather thought the day of the reaper would never come. He had used a sickle. I remember that one hung in the old attic at home. It must have

been quite like the sickle of Bible times. It was a single curved knife, the cutting edge being on the inside of the curve. The sickle had a short wooden handle. The reaper grasped a handful of the ripe stalks of grain in his left hand, and with a swing of the sickle, cut them off and threw them down."

"I thought grandfather said he used to reap with a cradle," said Don.

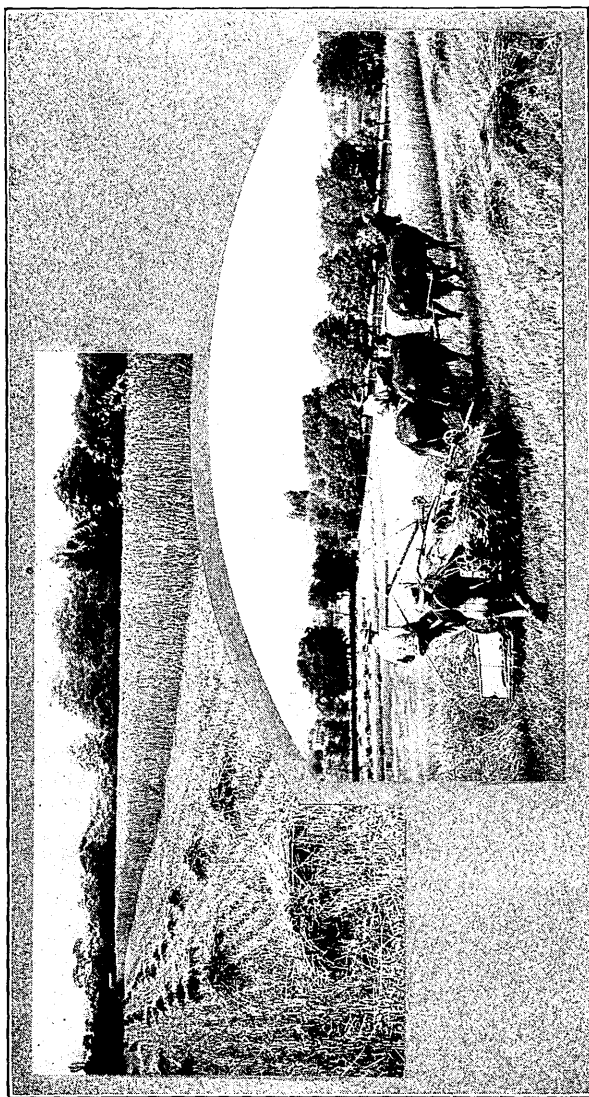
"So he did," answered father, "and he thought that was a vast improvement over his father's sickle."

"How was it different from the sickle?" asked Ruth.

"It had a long and slightly curved blade," answered father, "shaped something like a scythe, with several similarly curved arms of wood, arranged at regular intervals above it. On the long wooden handle were two pegs by which the reaper swung it. It was better than the sickle because one could cut the wheat much more rapidly, and then the wheat, falling against the wooden arms, was laid in orderly heaps on the ground, and so was much easier to bind into sheaves."

"But wheat is cut to-day by reaping machines altogether, isn't it?" asked Ruth.

"Yes," answered father, "but you must remember this was not always so. It is not yet a hundred years since the very first reaping machine was tried out. Cyrus McCormick, a young farmer, ran the first reaper on his own farm in 1831. After that, Wood, Marsh, Osborne, and others added improvements from time to time, till the old hand cradle was banished from the farm forever."



United States Department of Agriculture. (By permission of *Nature Magazine*, July, 1924)

REAPING THE GOLDEN GRAIN

"Then Ruth ought to ask all these men to share her loaf, oughtn't she, father?" asked Don.

"Indeed she ought," smiled father. "And she must not forget Deering, who made the first really successful binding attachment for the reaper. There had been binders before, but they required wire to bind and tie the sheaves. Of course bits of this found their way into the throats of the farmers' cattle, and Deering worked till he learned how to use twine in the binder, and save all the suffering and loss that the wire caused."

"And we haven't said a word about the mill men who ground the wheat, sifted and packed the flour, and shipped it to us," added Ruth.

"And there were others who helped in making the sugar, digging and refining the salt, and preparing the yeast you used," said Don.

"I am thinking of another group of friends who also helped," said mother, smiling, as she gathered little heaps of the crumbs on the table cloth.

"The birds!" cried Ruth. "How did I ever forget them?"

"And the plowmen earthworms!" laughed Don. "And the horses! I am sure they helped somewhere in the process. Who knows but that the beavers helped too, by building a meadow, long ago, on which the wheat grew?"

"It is not impossible," said father.

Ruth laughed merrily. "What a funny dinner party we would have had if all the people and all the creatures that helped me make a loaf of bread had come!"

"And yet if any one of them had failed to do his part, we might have had no bread for dinner," said mother.

Don looked a little sober at the thought.

"We could get on without pie, cake, and goodies of that sort," he said, "though I should not like it very well; but what ever would we do without bread?"

"We would be in a very bad way, would we not?" agreed mother. "That is why people call bread 'the staff of life.' It is our most important food. Jesus was thinking of this when he taught his friends and helpers how much they needed him. He said they must depend on him for daily strength just as they depended on bread as the chief part of their daily food. He said: 'I am the bread of life. I am the true bread, the bread your heavenly Father gives you. The man that eats of me shall never be hungry.' Of course you know he was thinking of soul hunger, and meant that the persons who follow in his ways shall be satisfied. They who hunger after right ways and right living shall get satisfaction."

"I did not know the Bible verses meant all of that, mother," cried Ruth. "I will think of it when I make my next loaf of bread. It will not be just a loaf that I 'make all by myself!'"

"No, indeed!" said mother. "When you sing in Sunday school

'Bread of heaven, Bread of heaven,
Feed me till I want no more,'

you think of Jesus and what he has done for you; and when you eat one of these firm, white slices you may let it remind you of him and of all the helpers whom God has set to work for one another in his great wonder world."

Something to do:

1. Jesus talked one day to the Jews and to his friends about being the Bread of Life. Find out what he said, and what had happened the day before.

2. Trace from your geographies an outline map of the world, and on a large sheet of paper make a harvest calendar, and show that wheat is gathered in some part of the world every month in the year.

3. Look for pictures of wheat fields, reapers, flour mills, bakeries, loaves of bread, and other such pictures. You will easily find them in the advertising pages of magazines. Put them together to make an interesting story of a loaf of bread.

4. Find and illustrate the verse that begins "Back of the loaf is the snowy flour."

To learn: Psalm 81. 16; *or* Psalm 147. 14; *or* Psalm 103. 1-5.

To read or sing: The hymn, "Come, Ye Thankful People, Come."

Jesus said unto them, I am the bread of life; he that cometh to me shall not hunger. My Father giveth you the true bread out of heaven. For the bread of God is that which cometh down out of heaven, and giveth life unto the world.—John 6. 35, 32, 33.

PART IV
FOUR-FOOTED COMRADES

LESSON XXIII

DOG COMPANIONS

OPEN your geographies to the map of Alaska. On the western coast you will find a tiny black dot marked "Nome." Put your right thumb on this dot, and place your first finger on the smaller dot on Norton Sound, which is marked "Shaklolik." It is not far from one place to the other, is it? Not far on a printed page, surely. Not very far, if you were to travel from one point to the other in a comfortable Pullman car. But suppose you had to make the trip in a blizzard, with snow whirling in a blinding mass about you, the wind blowing at you as you have never even guessed the wind could blow, and the thermometer marking such a cold as you never knew could be, do you not think that every one of the miles from Shaklolik to Nome would stretch out till it seemed ten times as long as it really is? Suppose, too, that your way of travel is not by Pullman, and certainly not by auto, but by dog sledge!

You may remember reading of the men who took this journey, and their reason for doing it. Early in the winter of 1925, a cry of distress reached the United States from the city of Nome, the largest city in a vast territory that reaches a thousand miles to the east, and extends north to the arctic circle. This was the pitiful message sent out by the doctors of Nome:

"Diphtheria has broken out, and we have used all our anti-toxin. Send us more quickly!"

You probably know that diphtheria is a disease that is dreaded anywhere, though much of its fear has been removed since doctors have learned to check it by the use of anti-toxin. In the cold north, however, diphtheria is especially severe, and so many of the people have died with it that it is there called "the black death." Everyone knows this, so you can guess that as soon as the message was received, the precious anti-toxin was hurried on its way as fast as steam could take it. But the railway does not reach to Nome, so preparations were started as quickly as possible to carry the serum from the end of the railway to Nome.

"Of course," you say, "there were flying machines to hurry the medicine to the sick people as fast as ever it could be taken." Indeed, there were flying machines, and men ready to risk their lives to get the serum through to Nome. But the authorities said that the storm was far too heavy for flying machines. The serum might be entirely lost. A safer way must be found.

You know what way was chosen. You know how all the world watched the brave struggle of "Scotty" and "Balto" and their drivers to get the precious medicine through in shortest possible time. You have read of the storm, so thick that once the team and driver passed through a village without knowing it. You have read that only the lead dog's keen sense of smell kept them all on the trail when the blinding snow hid the way. You have fairly danced with joy when you came to the end of the tale, and you knew that the medicine arrived in time to stop the sickness and save many lives, and you have looked at Balto's picture,

and wished you might throw your arms around his neck and tell him you thought him the finest dog that ever lived, for, without him and his good



(Drawn by Ralph O. Yardley, Stockton Record, Stockton, California)

MESSENGERS OF MERCY

Alaskan dogs that brought anti-toxin to save life

sense, perhaps the serum would never have reached Nome.

You may have heard how the dogs helped in

finding the north pole. Admiral Peary was brave and persistent, but he has said many times that he never could have reached the north pole if he had not had his brave and faithful dogs.

Again and again men tried to reach the south pole, and again and again they failed. Finally they followed Peary's example, and secured dogs to help them. But, as there are no dogs at the south pole, the men sent north for them, and when they returned this time from the antarctic regions, they brought the news that the dogs had carried the expedition through to the south pole!

Probably not a boy or a girl who reads this book does not know something of the part that was played by dogs in the great World War. Dogs were used for sentinels, and they distinguished themselves in the Red Cross Service. They were sent out with first-aid kits and packages of food strapped to their backs, and more than one home to-day is happy because a loved one was saved through the help of these dogs. Dogs were often used to carry messages, and were said to be three times as good as men in this work! They swam streams, crossed No Man's Land, crawled through barbed wire entanglements, and let nothing stop them till they found the masters to whom they were taking the messages.

Sometimes, too, sledge dogs saved whole companies of soldiers by dragging to them in the mountain heights the ammunitions that could be taken up to these steep trails in no other fashion.

But it is not alone in war or on scientific expeditions that dogs have served men well. You will be delighted to know that dogs have helped more

than once to carry the dear story of the love of Jesus for all the world to people who have never heard it. Archdeacon Stuck, the first man to have climbed to the top of Mount McKinley, was a devoted missionary. He traveled thousands of miles with a dog team, and taught the Indians the story of the gospel. Egerton Young, another great missionary, wrote a fascinating book, called *My Dogs of the Northland*, in which he tells of the bravery, cleverness, and help of the dogs. You will have a delightful time in hearing or in reading these stories.

Perhaps you are beginning to think that too much is being said about the unusual dog, and too little about the more ordinary friend who is playmate, companion, or watch dog for us. We should be quite wrong to forget these four-footed friends whom we depend on in many ways, even though they may not have performed any very remarkable deeds.

The stories of the famous Saint Bernard dogs who are trained to rescue travelers lost in the snow are known to every child. Less often do we think of and give praise to the shepherd dogs without which the farmers would find it difficult to carry on their work. This is especially true in Scotland, where the heavy mists that often hide the hills makes a dog worth more in sheep tending than a man. The dogs' keen sense of smell makes it possible for them to find the sheep in weather in which a man can see but a very short distance.

The skill and intelligence which the shepherd dogs display in caring for sheep is very wonderful. Stories are told of dogs that manage a drove of several hundred sheep with almost no direction from

the master. Such a dog has been known to drive a great flock of sheep from the pasture to the fold, separate the little lambs and their mothers, and drive them to one fold, while all of the other sheep were put in a second fold; not a single mistake was made, and not a single animal was harmed or frightened. You would think a man who could do as well was very skillful indeed, would you not?

A delightful tale of a shepherd dog and his work on a Scotch farm is *Bob, Son of Battle*. His intelligence and his skill are most interestingly described, and you will like the story very much.

It is said that a good dog has in his life one person whom he fully owns as master; one person to whom he will always give his love and his trust as well as his ready obedience. Many times dogs, losing their masters, show their sorrow in very touching ways. *Greyfriars' Bobby* is the tale of a little terrier whose master died and was buried in an old churchyard, and from the day when Bobby saw the earth close over the casket, he never was very far from the grave. You will love this pretty tale of a faithful little dog.

Perhaps you ask where dogs were first found, and if there are yet any wild dogs. This is a question that no one is quite able to answer. It is supposed by many wise people that dogs came from the taming of the wolves. One dog lover who also loves a joke tells of entering a tame wolf in a dog show one time, and of fooling many of the people in this way! Animals that resemble our dogs are found wild in some parts of the world, but we cannot be quite sure that all modern dogs came from such ancestors. We are only rather sure

that, of all the animals tamed by man, the dog has lived with him the longest.

How did man happen to tame a dog in the first place? Again we can only guess. Perhaps dogs crept up to the warmth and comfort of man's fire. Perhaps a cave man brought home some puppies for his children to play with. Perhaps wild dogs began to follow man, and to use for their food that part of the game which he did not carry away. Perhaps man saw that dogs were so fleet that they could overtake game more easily than he could, and so he had the bright idea of taming them to help him in hunting. At any rate, from very early times dogs became the companions and the helpers of men. Men and dogs have lived together and worked together and played together for so long that we can only guess as to how the partnership began.

But, though for many years the dog has lived with man, he still shows some of his original habits. Every one of you has seen a dog about to take a nap in his basket or on the lawn. What does he do first of all? He turns round and round, several times. Has someone told you that he does this to smooth his bed? Do you suppose the wild dogs or the wolves found this a useful habit, since it not only made a soft nest for them, but drove away snakes and other creatures that might have hurt them?

Probably you have to be careful in feeding your pet dog, or he will eat too much. You say he is a greedy fellow, and that he is not wise enough to stop eating when he has had all that is good for him. Perhaps his greediness comes from a time,

long ago, when he did not have any certainty that food would be at hand when he was hungry. Then it was the part of wisdom to eat all that he could, as there was no telling when he might find the next meal!

There is a dog on my street that gets many a scolding, and not a few whippings, because he will run out and bark at passing autos. "Silly dog!" you say. "He never can catch one, and he may get badly hurt."

"Silly people!" it would be more correct to say. For this habit of the dog, annoying as it is now, once helped to save his life, in those long ago times when his food depended on his jumping first and thinking second! If he had not done so, he would have gone hungry many times. You see, what my neighbors wish their dog to do is to think first and act second. If he could do this, he would not chase autos, for he is a good and obedient dog. But he cannot unlearn the old habit of jumping and then thinking.

What other old habits has your dog kept? Study him to find out. If you think yourself back into his old life, perhaps you can tell why he bays on moonlight nights; why he waves his tail in friendliness, but lowers his head to growl. If you can discover some of the reasons back of the way your dog behaves, you will understand him very much better and know how to treat him with more wisdom.

Do you ever wonder why the Bible says so little that is good about dogs? Some people tell us that it is because the nations among whom the Jews lived worshiped dogs, and so the Jews came to hate the dog. Others say that it is because in the

land of the Hebrews dogs were the scavengers of the streets, and were considered unclean. Yet even the people who did not like dogs could not but see what faithful friends they could be. It is said that Caleb, who went to spy out the land of Canaan and brought back the good report of the land God was giving the people, was named Caleb because this word means the *faithful dog of Jehovah*. If this is true, it proves that these people, living so long ago, honored the dog for sticking so close to his friends, does it not?

To-day we know still better how much we owe the dog. He has helped man in the chase; he has protected man and his property. He has worked, and often worked very hard, for man; he has served in many ways. We are only playing fair when, in our turn, we protect and care for the dog, and treat him with kindness and consideration.

Something to do:

1. Read the story of a brave little dog, "Stickeen," written by John Muir. Read also his account, in *Travels in Alaska*, of Stickeen's adventure on a glacier.

2. Read Isaiah II. 6-9. Is this a true picture of the way man now understands and meets his animal friends? Does it mean that, when mankind becomes more tender and loving, animals will be less fierce and much tamer? Read what Mr. Darwin says about the tameness of animals that he found in places uninhabited by man. What can you do to make the Isaiah picture true *now*?

3. Find the story of "Gelert," a dog that made himself famous through his care of a little child. Tell it to some child who cannot come to your class.

4. Plan with your classmates to make and keep filled a drinking fountain where dogs and other small ani-

imals may easily find fresh water to drink. A pan sunk in the ground, or fastened so it will not tip, and kept filled, will answer, if you can do nothing better.

5. List and read several good dog stories. Which one do you like best, and why?

To learn:

Proverbs 17. 17: **A friend loveth at all times.**

LESSON XXIV

A FAITHFUL SERVANT

Hast thou given the horse his might?

Hast thou clothed his neck with the quivering mane?

—Job 39. 19.

WHEN you read the list of four-footed friends in this book, perhaps you smiled as you came to the horse, and said: "Here is a mistake! Horses do not count nowadays. Automobiles take their place almost entirely." Perhaps you went on and thought of the ways in which horses were used a few years ago, and of how so much of this work is now done by automotive power.

Once, it may be, you heard the *clop-clop* of the horses' feet on the pavement before you were fairly out of bed, and you knew that the milkman was bringing, behind his sleek horses, the milk for your breakfast. The grocer, the butcher, the dry-goods man, all brought their supplies to your door in a delivery wagon drawn by horses. Father came to you on holidays with the suggestion for a ride, and this meant getting into a horse-drawn buggy. If you spent a summer on the farm, you saw the plowing and all of the farm work done by horses.

To-day horses are not so much in evidence either in the city streets or on the farms. It might seem that we are quite safe, then, in saying that the day of the horse is over. But we shall be quite mistaken if we do say this!

You know what the census is, and you know that at certain times, perhaps once in ten years, men come to all of our homes, and make a count of the people, to see how many there are in this great America of ours. At the same time, they count the horses, together with cattle, mules, sheep, and any other animals that play an important part in our life. This has been done for many years, so, if we can get the census reports, we can tell how horses have decreased in number. Are you quite ready to be surprised?

The census returns show us that we now have in our country 300,000 more horses than we had twenty years ago! It does not seem possible, does it? And we must remember, too, that, between the years 1915 and 1918, 950,000 horses were shipped abroad to be used in the Great War. Does this look as if the day of the horse were over?

It is true that horses are not so numerous in the city streets, and certain good things have come as a result. It is also true that much of the hard and heavy work on large farms is now done by power machines of one kind or another. But the government reports show that on small farms it is often cheaper to use horses than tractors.

No one can tell just how long man has counted the horse as one of his four-footed friends and helpers, but it is probably a very long time since the first horses were tamed and made to serve man. Their intelligence, strength, and obedience have made them of the greatest value and service to man.

Some of the wise men tell us that very, very

long ago the creature from which our horses of to-day are descended was a small animal, perhaps about as big as a fox. That, however, is not the strangest thing about this long-ago creature. Did you ever look at a horse's foot? How many toes has he? One, you say. Yes, and this one toe is inclosed in a case, the hoof, we name it, which is just a sort of big, horny toe nail.

But the long-ago horse had five toes! We can tell this from the bones dug up in old deposits which are found in different parts of the earth.

This is but part of the story. Later deposits show similar animals with four and three toes. Some day you will go to a great museum, and see, in orderly arrangement, the skeletons of these animals that lived ages ago, and you can trace for yourself the changes through which they passed in losing their toes. How did it come about?

Put the palm of your hand flat on the table, and slowly raise it on the middle finger till the thumb is lifted from the surface of the table. Raise the hand yet more, and which finger is next to leave the table? Yes, the little one. If you still lift your hand, keeping the middle finger on the table, you will presently lift the first and third fingers from the table, and only the middle one will touch.

Now, it is supposed that the horse of this very long-ago time of which we have spoken, walked not on the soles of his feet, as do many animals, but on his toes. When he was chased by other animals, he rose to his tiptoes and found he could run faster in this way, and so escape his enemies. Presently he lost the toes that he did not use. In course of time he came to support all his weight on the middle

toe, and the nail of this grew strong and became a fine protection for the toe.

In place of the lost toes you may see faint traces, odd little bony prominences, on the back of the horse's foot, that seem to prove the truth of the idea, and tell us a little about the five toes that horses once had in that very far-off time.

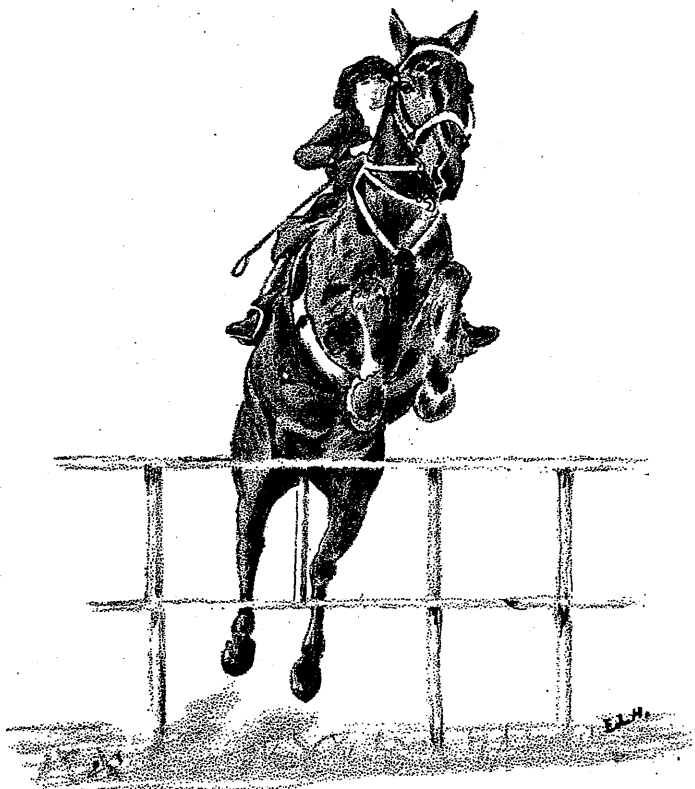
Would you like to know how and why man set out to tame the first horse he had? Here again we can only guess. Perhaps some ancient hunter caught a straggler from the herd; perhaps he took home a slightly wounded animal. Perhaps that old horse tamer was clever enough to see that, if he could catch one of these swift wild beasts, and teach it to obey him, he could get far more game.

There is little doubt that men at first hunted horses both for their flesh and for their skins. Later the animals were used as beasts of burden, and long before Job wrote his splendid description of a noble war-horse, men had used horses to carry them to the chase, to ride to battle and to drag their war chariots, and from that day to this there have been many famous war horses.

Look up the names and the stories of some famous horses and their riders. Robert Browning, away on a visit one time, and longing for a gallop on the back of a lively horse, took that ride in imagination, and wrote "How We Brought the Good News." Find the poem and enjoy the ride on Roland yourself.

What boy or girl has not heard of Sheridan's famous ride? Or who has not read the chariot race in Ben Hur, and loved the swift Arabian horses that brought victory to the hero? In the Civil

War, General Grant's "Jack" and General Lee's "Traveler" were almost as well known as their famous riders. How large a part horses played in



(Drawn from a photograph by F. L. Rounds)

WONDERFUL JUMPING MARE, "VIOLETTA," VICTORIA, B. C.

that dreadful struggle we can see when we read that in the year 1864 500 new horses were required for remounts for the cavalry every day, and that

40,000 horses were used in the first eight months of that year.

When America was discovered by Columbus no horses were found here. Many years later large bands of wild horses were discovered, and it is supposed that these were the descendants of horses brought into this country by the Spanish from Mexico and left behind when their men were obliged to go away. The Indians in time became very clever in catching these wild ponies, and the whole life of the Indian was changed because he began to make use of horses. You can see how this might be. The Indians, mounted on swift and strong horses, could go much greater distances in hunting, and when one tribe got into the land claimed by another tribe for hunting, quarrels arose, and war often followed. Can you think of other changes that might also come?

The beauty, the grace and the strength of horses have combined to make them favorite models of artists, and many famous pictures of horses have been painted. A great woman artist painted a wonderful picture of horses at a fair. What was her name? Write it in your notebook under a small copy of the picture. Did she paint any other pictures of horses? of other animals? Which of her pictures do you like best? Why?

There are so many types of horses that merely to give the names would take far too long. Horses are chosen according to their suitability for the use to which they are to be put. For heavy, hard work, Percheron horses have always been popular, though many Canadian farmers prefer the big Clydesdales. Carriage horses will be chosen for swiftness

rather than strength. Boys and girls will think a pony is more desirable than any horse ever seen, and the little Shetland, strong, hardy, and patient, makes a splendid pet.

The Iceland pony is not so well known in our country as the Shetland, but he is a useful and sturdy animal, well fitted to live in his cold home. The hairy tail of the Iceland pony shows one of the ways in which our Father fits his creatures for their own place. You have noticed in pictures that these ponies have tails from which the hair grows quite to the top. Did you think this was a mere oddity? It is much more; it is a part of God's plan for the comfort of this patient little horse, whose days must often be spent in the cold and snow. When the wind blows and drives the snow before it, the pony turns his back on the icy blast. The hair of his tail spreads out like a fan. The snow soon tangles in it. Do you think this must be very cold and disagreeable? Quite the contrary! The coat of snow, caught in the hairy tail, makes a good screen that serves to keep the pony warm. If the snow were to blow under the tail, it would melt and run down the pony's legs and presently, when the melted snow froze, the poor little animal would be most uncomfortable. Such a bushy tail is as useful to the pony as is the queer flat tail to the beaver, is it not? Do you not think the plans God has made for his creatures to live comfortably and conveniently, each in the place where he has been put, are very wonderful?

It would not be quite fair to close the story of the horse's service to man before we talk for a minute of the help that has been given to making

people well by our good four-footed friend. Part of the story you can find out for yourself by asking your doctor or nurse friend to tell you how the surgeon uses horse hair in his work. This is such an important part of the horse's gifts to man that I am sure you will think it quite enough. But even this does not tell all the story.

You remember how well dogs served in getting the diphtheria serum to Nome. Horses never could have made that terrible journey, and had it not been for the faithful dogs, most of the sick people in the cold north would have died. Yet, if it had not been for horses, the journey would never have been made.

Do you ask how this can be? It is because the horse, with his great strength, and his fine, clean blood, is of use in making the medicine that kills the deadly diphtheria germ. It costs the horse little or nothing to give up a few drops of his blood, from which in his laboratory the doctor makes the anti-toxin that saves lives. But this is just what happens. The horse has already saved thousands of lives in this way, and he doubtless will save thousands more in the years to come. Do you not agree that the debt we owe the horse is a very big one? When you look at a horse, you will think of what he has done for man, and feel very grateful to this four-footed friend that the heavenly Father has given you.

Something to do:

1. Read the poem, "Sheridan's Ride."
2. Illustrate the nursery rime, *I had a little pony*, and

use the finished work as a gift to a little sick or shut-in child.

3. Mount a small reproduction of "The Horse Fair" (Rosa Bonheur) for your notebook. If possible, you and your classmates should buy a large copy of this picture to hang on your schoolroom wall. Learn the story of the painter of this picture. Find out if she painted any other pictures of horses or of animals.

4. Make a collection of pictures of horses. Write an imaginary story about the picture you like best.

5. How did the coming of horses to this country change the history of the United States? Perhaps you cannot give all of the answer at once, but do not be discouraged. Ask your teacher about it, and read in your histories. Use your imagination and then prove your ideas to be right or wrong by looking up the facts in books in the library.

6. Find in a magazine or storybook a good tale of a horse, and learn to tell it to the class.

To learn: Proverbs 21. 31.

To read: Job 39. 19-25.

LESSON XXV

WORKING LIKE BEAVERS

I

Whatsoever ye do, work heartily.—Colossians 3. 23.

“WHEW! but I’m tired!” cried Don, throwing himself down in the swing couch on the shady porch.

“No wonder!” smiled father. “You have been as busy as a beaver all day.”

“Why do people so often say ‘busy as a beaver’?” asked Don. “Do beavers work more or harder than other animals?”

“You would think so,” replied father, “if you could watch them in the busy season, when they are building their houses and dams, digging their canals, and laying in the supply of food for winter.”

“What is their winter food?” inquired Don, with interest. “I supposed they ate fish and such things; they surely do not store those.”

“Certainly not!” agreed father. “Beavers are vegetarians, and live on the bark of aspens, cottonwoods, willows, and birches. In the summer, water grasses, rushes, and the roots and stems of water lilies are eaten. Beavers will not often cut hard woods like maple and ash, unless a scarcity of food compels them to do so.”

“But I do not see, father,” protested Ruth, “how beavers can cut trees. Doctor Cookman showed me a stuffed beaver at the museum; it was just

about this long," and Ruth measured off with her hands a distance of a little more than three feet.

"That is about average size for a three-year-old beaver," agreed father. "But tell me, did you notice the mouth?"

"Oh, father," cried Ruth, "it is the queerest mouth! It shuts up and down, instead of across, and behind the teeth instead of in front of them!"

"Good for you, Ruth!" cried father. "That is a fine description. Now tell me about the teeth."

"There are two on each jaw, quite long," answered Ruth promptly, "and they look very sharp, almost like chisels."

"Do not be surprised," said father, "when I tell you that these teeth are the tools the beaver uses to cut trees. An old beaver will work so busily that in a single night he will fell a tree three or four inches across, cut it into sections of four to eight feet each, and drag them to the water. Do you wonder that people speak of 'working like a beaver,' Don?"

"But I do not understand yet, father," said Ruth, "how the beavers cut trees down, even with those sharp teeth."

"Sometimes," answered father, "several beavers work on the same tree. More often each works independently. Each stands on the hind legs, balances the body with the big flat tail, and cuts out pieces of wood, perhaps throwing the head back, or perhaps tilting it to one side, and splitting out the chips in this fashion. Beavers show much intelligence in selecting the trees to be cut. They seldom go more than fifty or sixty yards inland, and they have been known to pass by trees that were sure to fall into other trees and so get tangled

in the branches, for trees that stood in open places. Another reason for the choice of trees that grow near the water may be that the beaver moves slowly and clumsily on land. One can be easily overtaken by a person. The beaver seems to know this, and to keep close enough to the water to be able to reach it quickly in time of need, or in case of pursuit."

"What sort of homes do beavers have?" asked Don.

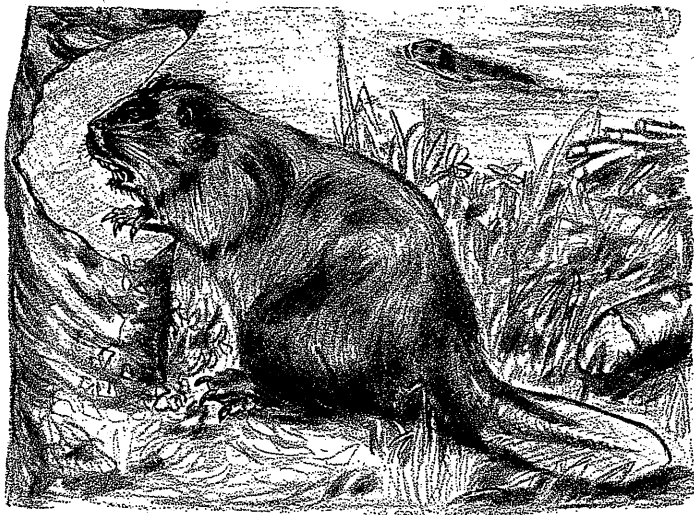
"Beavers build a house, often starting it from the bottom of a pond," answered father, "by piling up sticks and mud for five or six feet till the water level is reached. Then still more sticks, stones, and mud are added, till a living room big enough for the beaver family is completed. It looks somewhat like a rounded oven, and may be rather rough and open at first. Long before winter comes, and the first frost is felt, the walls will be made thick and strong. Sometimes the walls will be three or four feet thick. Sticks are laid over the outside in every direction, and when mud and sod are plastered over all of these you can guess how firm the whole thing must be."

"How does the inside look?" asked Ruth, who had been listening with much interest.

"The inside is a rounded chamber, possibly six to eight feet across and three feet high. The sticks have been gnawed off on the inside so that a smooth wall is made. A bed of grass, leaves, or the chewed-up wood is made a little distance above the water level, and quite near to the water hole."

"Do you mean a sort of drinking fountain, father?" asked Don.

"No, no," laughed father. "It is a safety door, to get in or go out, in times of danger. All beaver houses have one, and perhaps two such holes; they come out under the bottom edge of the houses, perhaps thirty-five or forty feet away. If something frightens the beaver when he is at home,



(Copied by E. L. Howe by permission of
Nature Magazine)

Painted by R. Bruce Horsefall for *Nature*
Magazine, April, 1925

THE AMERICAN BEAVER

he dives down through one of these holes, and may next be seen a half or a quarter of a mile away."

"Then a beaver must swim well under water," said Ruth.

"Yes, indeed!" agreed father. "They have been known to stay under water for fifteen minutes, though this is not at all usual. Three or four minutes is the rule."

"I wish I could stay under water as long as that!" sighed Don.

"You could if you were as well fitted to do so as is the beaver," laughed father. "The beaver's nostrils close up under water. His ears are furlined, and also close under water. Because of the 'queer' mouth which Ruth mentioned a few minutes ago, shutting behind the long teeth, water does not get in when the animal is getting roots or sticks below the surface. He can use his small front feet for hands, since he must do all his swimming with his large webbed hind feet."

"I think the beaver's tail is about as queer as his mouth," said Ruth.

"I agree with you," said father. "If you knew nothing about the beaver's life, you might almost be ready to say that tail is a mistake, when, actually, it is a most useful member!"

"What is it like?" asked Don. "You know I did not see the beaver, as I could not go with the class the other day."

"It is broad and flat," answered Ruth, "and there is no fur on it. There are queer wrinkles in it that make it look at a little distance as if it might be covered with scales. How is such a strange tail used?"

"In the first place," answered father, "that tail is used as a balance. Can you not see how it must help the animal to stand when he is raising himself on his hind legs to cut a tree? Or picture one coming from the bottom of the pond with his forearms full of mud and stone which he is to carry to the top of his house; how that tail will help to keep him from tumbling over!"

"Of course!" cried Don. "What else, father?"

"Perhaps the second thing of importance is that it serves as a danger signal. Beavers are always on the alert for danger, and at the first sign, they take to the water. As they reach it, the big flat tail comes down on the surface with a slap that can be heard for a long distance. Every beaver within hearing at once heeds this signal, hurries to the water, and in turn gives his signal of warning."

"I like that tale of a tail, father," twinkled Ruth, "and I won't call it a queer tail again."

"But that is not all," father went on. "Beavers often need to float the trees that they cut for some distance down the stream to their houses or dams. Imagine them tugging at the end of the log and trying to guide it. How do you suppose they ever keep from going around in circles?"

"I kept my boat straight by the rudder," said Don, slowly, "when I was on the pond last year. The beaver must need a rudder too. Oh, I see, father! This queer tail is his rudder!"

"Exactly!" agreed father. "In addition, many people who have had the chance to study the beaver closely think he uses his tail as a propeller when swimming. He swims very fast, and seems to use both body and tail. You see, it is not very safe to make too quick judgments on the value or usefulness of a member merely on the ground of its appearance!"

"Why do beavers build dams?" asked Don.

"Beavers are very dependent on water," answered father. "They are so much at home in it that they are more water than land animals. It is in the water that they are safe from most of their enemies,

and so they build dams across shallow streams to make the water deep enough to protect their houses."

"Do they make the dam in the same way as they make their houses?" asked Ruth.

"Yes, much the same fashion," replied father. "They work from the upstream side, and begin by floating down sticks and branches of trees. Then they add grass, mud, stones, and such material. Soon the water is checked in its flow and begins to rise. Then the beavers permit the sticks to fall over the top, and lie crisscross on the lower side, where they add more mud to hold it fast. So the dam grows, till it is high enough and strong enough to stand floods and to make the water supply secure. If a leak comes in any spot, the beavers repair it very quickly. Some of the big dams are very old and have been made by many beavers working through a long period of years, though the dams are still strong. Beavers are very good engineers indeed."

"I should think beavers would need to wear waterproof suits if they are to live and work under water so much," laughed Ruth.

"That is exactly the sort of suit our wise heavenly Father has given the beaver," said father. "The soft fur such as trims your winter coat is the undercoat, and is waterproof. The outer hairs are called the guard hairs. They are coarse and generally of a dull brown. But the beavers keep them in excellent order by using the curious combing claw that grows on the two inner toes of each hind foot."

"That is better than having a vanity comb in your pocket," chuckled Don.

"The beaver is not a vain animal," replied father, "but he is a very neat one. His house is always well kept and clean. Some observers have written of the insects that make their home in the beaver's fur, but our government experts tell us that the animal is remarkably free from all such parasites. I suspect that his love of cold water makes him both healthy and clean."

"Same with boys!" grinned Don. "Do you suppose beavers get as much fun from their swimming as we fellows do?"

"I am sure of it!" replied father. "I have hidden myself near a beaver colony and watched them for hours at a time, through a period of several weeks. The older members of the colony apparently wander off during the summer months. I have wondered if they did not go exploring, looking for good places to found new colonies when the food supply of aspens runs low where they are located. The young beavers, and sometimes the whole colony, play like a group of lively boys and girls. The youngsters push each other into the water, dive, race, wrestle, and make merry generally. But you should see the beavers at work, if you would know what it means to be busy."

"Tell us, tell us, father," urged Ruth.

"Beavers do not work in the hustling, bustling fashion that men so often follow," said father. "When they are getting ready for winter, though, they work both hard and steadily, but without confusion. A number may be busy gnawing down aspens. Others will spread mud over the tops of the houses, so that when it freezes not even a bear can break through. Perhaps still others may be

cutting the felled trees into sections that can be floated down to the food pile, or to the dam, where another group of beavers may be strengthening the work to stand the floods that may come. Every one will be working steadily and with no hurry, but with quite an evident plan in mind."

"Do you suppose they have a leader, a sort of 'boss'?" asked Don.

"How I wish I could answer that to my own satisfaction!" cried father. "I have watched closely to discover any such leader, and have never seen anything to prove that one beaver more than another is head or chief, but the animals are so shy, it is difficult to get near enough to them to make sure of all that goes on. Perhaps you will some day have the opportunity to study them for yourself, and take pictures of them with a long-distance camera. You may be able to add a great deal to our knowledge of these interesting creatures, that have played so large a part in the history of our country."

"What do you mean, father?" queried Don, who was just beginning to show much interest in American history.

"That is another long story, for which we have no time just now. Look it up in your books, and we will talk of it later."

"Tell me something to find out, father!" begged Ruth.

"See if you can discover any useful part the beaver plays beyond furnishing you with a pretty trimming for your winter coat!" said father, with a merry twinkle in his eye that sent Ruth away thinking.

Something to do:

1. Canada has chosen the beaver as its national emblem. Why did it so decide?

2. Trace an outline map of the United States, and pencil lightly over that part where beavers once lived when the country was first colonized. Using a red or blue pencil, trace over the parts where beavers may now be found.

3. Write to the United States Department of Agriculture, at Washington, D. C., for Bulletin 1078, which tells of the beaver habits, control, and farming. You will find many interesting facts about these animals in this little pamphlet. It is free.

4. Read Longfellow's poem "Hiawatha," and get the story of the beaver as it is told there. Do you agree with the ideas about the beaver that you find in the poem?

5. Find and read one or more stories about beavers, in books written by Mr. E. A. Mills, or in the Nature Magazine.

6. Write at least three ways of living or working that beavers follow which may be well copied by boys and girls.

To learn: Romans 12. 11.

LESSON XXVI

WORKING LIKE BEAVERS

II

"ARE you ready?" asked father, with a smile at the eager faces of the two children before him. "Full speed ahead, Don!"

"I found so many new facts that I do not know where to begin in my story of the beaver as a history maker," began Don. "In the first place, beavers used to be quite common in Europe. But about the time that the New World was being explored, European beavers were getting very scarce, as they had been so trapped and killed for their fur, that few were left. When then it was found that beavers lived in large numbers in almost all of North America north of Mexico, I suppose those old trappers thought they had struck a regular gold mine in the way of fur!"

"But, Don, 'almost all of North America'!" cried Ruth, who was looking at a map in an open book. "Are beavers found in our country anywhere except in the Rockies and the Adirondacks?"

"Not now, to any extent, at least," replied Don, "but there was a time when they were spread over most of the country. Quite a number are still found in Canada. My book says they were found wherever the aspen grew, and that was the most widely distributed tree in North America."

"What happened to drive them out?" queried Ruth.

"That is a part of my story," answered Don. "The French tried hard to get the control of the entire fur trade so that they could do as they pleased and get all the money. The books tell of one 'grant' after another. Of course the English did not like the idea of letting the French have it all, and made plans to get their share. There were all sorts of quarrels between the fur traders. Many times a trader, or a company of traders, would load one or more ships with fine furs to take back to his homeland, and before he reached the other side, a ship of the rival country, or perhaps a pirate ship manned by fellow countrymen, would fall upon him, and rob him of all his furs; on one excuse or another. That was hard on the owner, but it was hardest of all on the beavers, which were being killed off in great numbers."

"Of course people were not thinking of the matter from the beaver's point of view," said father, "and it seemed quite unlikely that the end of the fur supply should ever be reached."

Don nodded.

"There was another interesting side of it, too," he added. "The trapper was often the first man in the new country. Of course he needed a point at which he could get food, or a place to go for safety, or to trade his furs. So posts were established for this. Sometimes they were not much more than a little cluster of huts. Often a fort was built for protection. But nearly every city in the Saint Lawrence and Mississippi valleys and many in the eastern part of the country were once built as a part of the big fur trade business that was going on in those early days."

"Quite right!" agreed father.

"The thing which I thought the very queerest of all was the part fashion has had in driving the beaver out," added Don.

"Do you mean the style of wearing beaver fur for trimming?" asked Ruth.

"That, of course, was the first thing," answered Don. "All through the days of exploring, the beaver's fine coat made him a hunted creature. But after England and France had settled the question of who should rule Canada, after the beaver had been pretty well driven to living in the wilder parts of northern United States and the Rockies, American men began to follow the funny style of wearing tall beaver hats. No man thought he was well dressed if he did not have one."

"I remember very well seeing my grandfather wearing such a hat," smiled father. "If someone had not invented a way of making tall hats out of silk, and if the fashion had not changed, the beaver might be even harder to find than is now the case."

"What makes me most indignant," went on Don, "is that trappers later used dynamite, and blew up whole colonies of beavers. I think that is not being a good sport; it is not giving the poor animal a chance for his life."

"You are right," agreed father, "and the government thinks as you do, and forbids such measures now. It is illegal to take beavers at all in certain seasons, and we are trying at last to protect and save them."

"We ought to save them," said Ruth, so earnestly that Don could not help smiling. "They are just about the best neighbors one could wish."

"Tell us about it, daughter," said father.

"This is about some Colorado beavers," returned Ruth. "A farmer in that State had a dry ranch, and from the little creek he could get just about enough water for a small garden. Then some beavers built on his creek, and by making a dam, saved the tiny trickle of water. The farmer would not permit a single beaver to be harmed. So the colony grew, and pretty soon the farmer had water enough for ten times as much land as there was in his little garden."

"Hurrah for the beavers!" cried Don. "But weren't their plans all spoiled when the farmer took their water supply?"

"No, indeed!" said Ruth. "They build up the dam as soon as they find it broken, and in a little time there is another water supply stored for them. More than one farmer in Colorado, so my magazine says, is making use of beaver dams in this way."

"It must save the farmers a great deal of money," said father.

"It does," returned Ruth. "Wait a minute, and I will tell you how much. I was afraid I could not remember, so I wrote it down," and she gravely consulted a small notebook. "The farmers thought that each beaver in the colony saved water enough to have cost anywhere from five hundred to one thousand dollars. What do you think of that?"

"That's great," cried father.

"Besides all that," added Ruth, "the men did not have to build the big watering plants, nor did they need to keep them in repair, and they saved just hundreds of dollars in that way. The beaver

needs nothing more expensive than sticks and mud, and when the dam breaks, he gets busy and mends it, sometimes almost too soon to suit the farmers who are thinking of their thirsty crops!"

"A pretty useful neighbor, I think!" cried Don.

"Yes, indeed!" said father. "But even this does not tell all the story of his service to man. You remember how the beaver dams are made?"

"Yes, of willow and aspen sticks, and stones, and mud," responded Don, promptly.

"You can see that, even when the dam is fresh and not yet tight enough to keep back all the water, it must check the flow, and make the stream run more slowly. What must happen then to the fine soil that is carried in the water?"

"Why, I suppose it must settle," said Don, slowly.

"Quite right!" agreed father. In this way, 'beaver meadows' are made. Of course the willows that are used in building the dam often begin to grow, and their roots help to bind the soil still more firmly. Generally the fine earth carried by the stream is very rich, and gradually a productive valley, a fine farm, or the place for a splendid orchard comes from the beaver meadow. E. A. Mills, a man who has studied beavers for a long time, declares that thousands of square miles of land have been covered in this way."

"Beavers sometimes do a little harm," said Ruth, "by making use of railroad culverts. Doctor Cookman showed me a picture of one such bridge where the railroad company had to keep an iron ladder on the spot for the use of the men who go every few days to take away the sticks and the stones that the beavers pile against it. If the water gets

too high, it may wash away the track, or make it so soft that the trains cannot run on it safely."

"But aren't they the clever little animals to make use of what they find?" asked Don, admiringly.

"They surely show a great deal of intelligence," agreed father.

"Sometimes people get out of patience with them because their dams flood good camping sites, and the water kills the trees," added Ruth, "but Doctor Cookman says the government sends out instructions as to how to drain these dams so as to save the trees and yet not harm the beavers."

"Oh, that's good!" cried Don.

"It is just because the beaver is so useful that the government makes such a careful study of him, and of his ways and his needs," said father. "There is no doubt that the beaver helps in flood control. He builds, not only one, but often two or three or four dams across a stream. Suppose, now, that somewhere in the upper part of the stream the trees have been burned or cut off. There is then little or no protection when the snows begin to melt. A heavy rain storm, too, would run off very fast. The stream will fill quickly. But when the water reaches the first dam, its flow is checked a little, and by the time it passes over the last dam, it has been so slowed up that the harm it does is slight."

"Hurrah for the beaver, I say again!" cried Don. "I think he is just about the most useful neighbor and helper we have found! I mean to do all I can to keep him happy and at home!"

"I quite agree with you!" said father. "The beaver is a useful and industrious citizen. He

lives in peace. He works hard and quietly. He plays hard too. He makes the best of things as he finds them, and he adds not a little, by his quiet work, to the beauty and usefulness of the world."

" 'Whatsoever thy hands find to do,' that seems to be his rule," said Ruth. "I think I'll be a beaver, and do my full share of the garden weeding and watering, after this, Don!"

Something to do:

1. Look up an article published in the Saturday Evening Post, May 1, 1926, concerning the fur trade in Alaska, and learn what you can about beavers.

2. Ask someone to help you find out what Parkman wrote about the beaver fur trade, and its effect on the settlement and the history of the United States.

3. Imagine yourself a beaver who is well acquainted with the history of his family and their work for a long time. Tell the class the story of what your (beaver) people have done for the United States. You may tell of land formed for farms and orchards, of water stored up for dry times, of ideas of dams given to men, or of food or warm clothing that saved them from cold and hunger.

4. Read Mr. Mills' *In Beaver World*, and, in the words of a young beaver, tell the story his grandfather told him (you!) about going from a wrecked home to a new colony; of the dangers encountered, and the adventures of the trip.

5. Write, in one or two sentences, the things about the beaver that you like best.

To learn: Romans 14. 7.

Whatsoever thy hand findeth to do, do it with thy might.—Ecclesiastes 9. 10.

LESSON XXVII

SHEEP AND THEIR SHEPHERDS

I am the good shepherd; and I know mine own, and mine own know me.—John 10. 14.

LONG, long ago, so long ago indeed that we can only guess about it, a man, feeling very hungry himself, and thinking, too, of his hungry family in the mountain cave which was their home, captured and killed a wild sheep, and carried it to his dwelling place on his shoulder. With a stone knife he cut off the skin, and his wife cooked the juicy meat on the fire that burned before the cave, or on the rude earth floor. Everyone had a fine feast. The man used the rough skin for a coat, and very warm and comfortable he found it. Quite possibly the children crept under it when they went to sleep at night, and thought it the cosiest covering they had. No doubt the cave wife liked the warm skin as a rug in her cold cave, though she probably cared more for the rich meat of the animal, which had tasted so good. Perhaps she urged her husband to hunt for more animals of the same kind; and he learned to be very cunning in stalking and capturing the strong and clever mountain sheep that could run so fast and jump so far and so surely.

We cannot be perfectly sure about any of the early beginnings, but it seems quite likely that man first learned in some such way as this of the value of sheep to him, and it is almost sure that he first

hunted the creatures for the sake of the food value, and that he used their skins as clothing as a second thought.

But when you think of the skins of these long-ago sheep you must not picture to yourself a thick, white woolly coat, such as you have seen on the sheep of to-day in a farmer's pasture, or on a great Western sheep range. Those first wild sheep probably looked much like the wild sheep that may still be found in certain parts of the world. Some day you may have the good fortune to see one of our Rocky Mountain sheep, and you will know then how the cave man's sheep looked. Till you can see a wild sheep for yourself, you may content yourself with a description of them, and you will find such a word picture in a book written by Mr. E. A. Mills, who has made a careful study of these interesting animals.

Another good description of the wild sheep is to be found in John Muir's book called *Steep Trails*. The first chapter tells of the hairy coat of the wild sheep, so different from the soft, woolly covering of our tame animal. The wild sheep's coat is not unlike that of the beaver in this way, that the undercovering is protected with light, elastic, shining hairs that make a splendid overcoat, an overcoat that will not tangle or mat, and that will very easily keep beautifully clean.

You may have seen a flock of our tame sheep some time after they have been shorn, when the wool has had time to grow long. You have noted how tangled and matted the thick fleece becomes, and how dust and dirt have worked into the oily mass, till the sheep is no longer white, but a dirty

gray. The wild sheep do not have this inconvenient and uncomfortable coat. The coat they wear was planned by the heavenly Father, in his wisdom, to exactly suit the places and the conditions in which the sheep were to live.

Do you ask how the tame sheep's coat came to be so changed? It came about slowly, largely through man's care. You would like to know exactly how man began to tame sheep for his own use, and so would we all; but we can imagine how it came about. Perhaps some hunter found a little lamb that had lost its mother, and he took it home to the children. Perhaps a sheep was wounded but not killed, and the cave man began his taming process when the sheep recovered under his care. It would not take man very long to find out that skins with the longest and thickest underhair make the warmest clothes. When he selected sheep to raise for clothing he would keep only those that had such thick coats, just as he would select the largest and heaviest sheep when he was choosing those that would make the best food.

We can guess rather surely as to what animals man tamed, from the bones that are dug up in the places where it is known that man made his home in the very earliest times. It is these bones that make us sure that sheep were among the very first creatures that man selected for his flocks. Probably, before this was done, more or less fixed places of living had been chosen. Perhaps rude houses had taken the place of caves as homes for people. The wanderings from place to place would be those that were necessary to find plenty of grass and good water for the sheep and cattle.

Gradually, as man began to care for sheep, their bodies and their coats changed. The light, stiff, shiny hairs of the outside coat little by little grew less common, and the thick undercoat grew thicker and longer, as only those sheep that had such coats were saved for breeding. As the wool increased in quantity and quality, more and more uses were found for it, and presently it became a very important reason for keeping sheep, though it was not until rather recent times that people thought more of the wool than of the mutton. The sheep as a food supply was long held in higher regard than as a source of wearing apparel.

How many things of everyday use that are made from wool can you name? Just to mention the ordinary articles of common use will require several pages of your notebook. Ask mother why wool is used for so many things, and she will tell you it is because wool makes warm clothing, or because wool wears well. Why is wool warm, and why does it wear better than cotton? See if you can find out the reason for yourself.

You will be surer of learning why wool is so useful if you can get a tuft directly from a fresh fleece, a tuft of wool that has never been spun or woven. If this is not possible, do the best you can with a bit of yarn, or the threads pulled from a rug, a blanket, or a piece of flannel. Wash the wool till it is free from oil and dust. When it is quite dry, pull it carefully apart, till you are able to look at each single little fiber. A magnifying glass will help you very much, as some of the facts you will wish to learn cannot be gained without one.

It will not take you many minutes to discover

that each tiny wool fiber is not a straight, smooth thread. Each is curled up like a wee spring. All your care will not make it smooth and straight.

If the wool you are looking at is new, and if your microscope is strong enough, you will see that, in addition to being twisted like a spring, each fiber carries a number of tiny hooks or barbs.

Try to twist a number of the fibers into a thread. You will see at once what must happen. All the little coils catch in one another. When you take the thread by the two ends and try to pull it apart, they do not slip readily. The tiny barbs help to hold too, and all of this makes a strong thread. But the coils do not allow the fibers to lie close together; air spaces are left between them. This makes a thread that, woven into cloth, gives a stuff that is warm as well as strong.

If at the same time you are looking at the wool you will study cotton fibers, you will note a great difference between the two. Cotton fibers are much shorter than wool fibers. They are not barbed, and they are not twisted. It is possible to make thread from cotton that is almost as smooth as silk, but, partly because the fibers are not coiled and barbed, and more because they are so much shorter, cotton is not as strong and does not wear as well as wool.

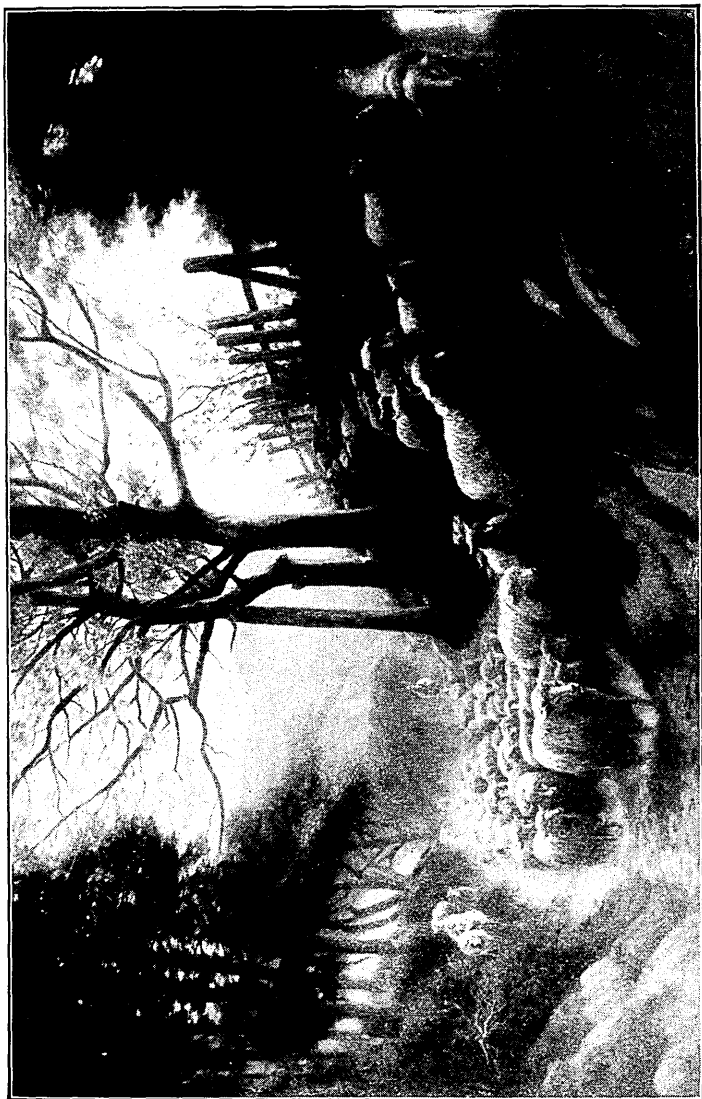
How do you suppose people first learned to twist wool fibers into thread and then to weave the threads into cloth? It would be a fascinating story if we could tell it. We do know what the very earliest spinning tools were, however. If you visit the Museum of Natural History in New York City some day, you may look at work baskets owned

by Indian women many hundreds of years ago. In them are still the simple spinning tools that were used.

Better than looking at these old baskets, you may make very good imitations of the old tools and spin a thread of wool for yourself! Find, if you can, a small stone, with a hole in the center. You can often pick up one on the beach. If you live far away from the seashore, you can make an empty spool serve your purpose fairly well, especially if you weight it slightly. This tool is called a whorl. You next should take a few fibers of the wool in your fingers and twist them a bit to start a thread. Fasten this to the whorl and let the weight of the whorl keep the thread twisting as you add more fibers. When you have made a few inches of thread, you will begin winding it on a spindle, which you may make from any small stick. A reed or a bit of wood slightly larger at the middle than at the ends is all that is needed, and the yarn is wound on it much as a boy winds his kite string.

All our modern spinning machines that to-day run by steam or electricity are just improvements of this old hand method of making yarn from wool. At what time the art of spinning was learned we can only guess, but it was very, very long ago. Ages before Abraham, men had learned to value sheep highly, and they knew how to care well for them.

Under the care of men, sheep changed in a way as marked as the changed coats they came to wear. For, as men took more and more care of their sheep, the sheep grew weaker and more de-



THE FLOCK GOING TO PASTURE

pendent. They were less able to care for themselves, less able to fight off their enemies.

The best part of this side of the story is that men came to see how much the sheep needed tender and watchful care, and that the shepherds gave it in full measure. So unselfish did shepherds show themselves, and so wise and loving was the help they gave the sheep, that when Jesus wished to tell his followers how much he loved them, he found no better way of making them understand than to call himself the Good Shepherd. He said: "I am the good shepherd. I know my sheep. I call them all by name. My sheep know me. They follow me. I go to hunt for even one lost lamb. I give my life for my sheep. The shepherd who is a hireling will not do this; it is only the true shepherd who cares for his sheep in this way."

Long before Jesus lived, a singer of Israel, David, the shepherd king, wrote what we have come to call the Shepherd Psalm. He gives a lovely picture of the faithful shepherd caring for his flock, and says that this is the way God cares for his people. Can you say from memory the twenty-third psalm?

Another writer speaks of people who will not follow God's way as silly sheep who have gone astray, and followed their own way, not listening to the voice of the shepherd. Have you ever seen a flock of sheep that would not heed their master's command? Sometimes just one foolish sheep will start to do the wrong thing, to go the wrong way, to escape from the safe pasture, it may be, through a break. What do the other sheep do? One by one they follow the example of the first foolish sheep, and go wandering away; they go astray,

and they do not know enough to come back till the loving shepherd goes for them, and leads them all back to their proper fold. Who would choose to be a sheep that has gone away from the fold?

The old Hebrews believed in a service of God that called for the sacrifice of lambs. When, after many years, Jesus came to show them, and to show the whole world through them, the way to God, he, like the lambs, gave his life to lead his followers closer to the heavenly Father, and because of this, as well as because of his gentleness and his obedience to his Father, we love to think of him as "the Lamb of God that taketh away the sin of the world." This was what John called Jesus, when he saw him coming to the River Jordan for baptism. What other verses can you find which speak of Jesus as the Lamb of God?

Something to do:

1. Make a spindle and whorl.
2. Wash a small quantity of wool, and, using spindle and whorl, make a thread of wool.
3. Look up in your books how weaving is done. Make a small loom from a heavy cardboard or the cover of a cigar box. String or warp your loom with cord, and weave a woolen rug for your doll house, or a mat for mother.
4. Find a pretty picture of sheep. Mount it, and write your favorite verse from the Bible concerning sheep below the picture.
5. In your notebook write the helps that sheep have given to men. Can you find ways of helping that are not mentioned in this book?
6. Find in the Bible the story of a little lost sheep and the loving shepherd that went to find it. Talk

over with your teacher the best way of telling this story. Perhaps you will decide that acting it out will be a very good way. Get ready to tell or act the story, and ask your mothers and friends to come to your class some day and hear it.

To learn: Psalm 23; or John 10. 12-15.

To read: "The Lamb," a poem by William Blake, beginning, "Little lamb, who made thee?"

PART V

THE EARTH AND ITS NEIGHBORS



LESSON XXVIII

SKYLAND AND CLOUDLAND

Who coverest thyself with light as with a garment;
Who stretchest out the heavens like a curtain;
Who layeth the beams of his chambers in the waters;
Who maketh the clouds his chariot;
Who walketh upon the wings of the wind.

—Psalm 104. 2, 3.

"Ah, there come the helpers who will bake our bread, cook our dinner, and clean our clothes!" cried father as he dropped the camp ax against the big pile of wood he and Don had just cut for the oven and the evening camp fire.

"Where?" asked Don, eagerly looking up the trail that led into the camp. "I see no one coming."

"Not that way," laughed father. "This way!" and he pointed to the sky.

"What, coming by airplane?" queried Don in great surprise, as he craned his neck to scan the sky.

"No, no, boy!" chuckled father. "I mean those big white clouds that are just beginning to show over the hill."

"Now, father," objected Don, "you have told me plenty of wonder tales that I know are true, but I do not see how clouds can bake bread, or cook meals, though," he added more slowly, "they might help us clean our clothes."

"I think I know what father means," said Ruth, from her seat on a big log, where she was busily stripping the outer husks from the roasting ears.

"You are thinking of the big power houses we saw on our way up to these hills, aren't you, father, and of the electric oven and the electric washer at home?"

"Of course!" cried Don. "The clouds will turn to rain, and the river will carry it down to the power plant. You did catch me napping that time, father."

"How high are those clouds, father?" asked Ruth.

Father looked up at the fleecy white clouds, piling higher and higher every minute.

"They are cumulus clouds," replied father, "and are probably about a mile high. That is the average height for that type of cloud. If they turn to cumulo-nimbus clouds, the form we sometimes speak of as a 'thunder-head,' they may grow till they are three miles from base to summit."

"Oh, father, those big names!" cried Ruth.

"Ho! those aren't hard words!" scoffed Don. "Not if you know Latin! '*Cumulus*' means 'heap,' and I think it is just the name for those big, puffy clouds that look like heaps of white wool. And '*nimbus*' means—it means—father, I am afraid I have forgotten just what it does mean!"

"Look off to the north," directed father. "That low dark cloud is a typical nimbus cloud. How does it look?"

"Oh, it must be raining there!" cried Ruth. "You can see the long streaks from the bottom of the cloud."

"Yes," agreed father, "it is raining, and that will help you to remember what '*nimbus*' means—'raincloud'; you see, it will not be hard at all."

"I heard grandfather talk of a 'mackerel' sky. What does he mean by that, father?" asked Don.

"Yes, and 'mares' tails,' too," added Ruth. "I think that is a funny cloud name."

"There are no clouds of that kind in the sky to-day," said father, "but I am sure I can explain so you will understand. Have you ever seen thin, feathery bands of cloud floating in the sky?"

"Oh, yes," cried Ruth. "They were all spread out like little bits of wool, or like flying hair."

"Exactly!" said father. "Those are cirrus clouds, and '*cirrus*' is another Latin word meaning 'tuft' or 'ringlet.' The cirrus clouds are much higher, usually, than the cumulus clouds. They are generally as high as the top of Mount Everest."

"Five miles!" exclaimed Don, recalling his geography very promptly.

"Yes, just about that," agreed father. "When such clouds spread out in bands they are often spoken of as 'mares' tails,' because, as you suggest, they look like masses of flying hair. They are formed of ice-crystals, and when the light of sun or moon shines through them they make 'rings' or 'halos.' The 'mackerel' sky is often a combination of cirrus and cumulus clouds, and generally comes in fine weather. The mackerel sky will show all sorts of lovely cloud formations, and may cover a large part of the sky with the clouds in orderly ranks and rows."

"But the cumulus clouds make the prettiest sky pictures," said Ruth.

"Cirrus for me," said Don, decidedly, "especially when they are all pink and yellow and violet at sunset."

"Father, why are some clouds pink, and some violet, while others are white?" asked Ruth.

"It is all due to another skyland helper of which we seldom think," answered father. "It is the dust in the air that gives the clouds their color."

"Do you mean the dust is colored?" asked Ruth, puzzled.

"No, no, not that," smiled father. "I mean that the tiny particles of dust in the air break up the light rays and scatter them, and that gives the lovely colors we enjoy so much. The reds of a brilliant sunset just mean that the rays have to struggle through denser, closer air, and that the long red rays of light are sifted out of the other rays."

"My professor at the school says that dust makes the sky blue. Is that true, father?" asked Don.

"Yes," answered father. "If there were no dust particles in the air, the sky would look nearly as black as it does at night, and the sun and the stars would shine so brightly that we would be glad to shield our eyes from the glare."

"Who ever supposed that dust was a helper?" mused Ruth.

"I have not yet told you of another very important way in which dust helps," said father. "Some wise men made certain interesting experiments a number of years ago, and they proved that dews, fogs, and gentle rains are the rule rather than floods and torrents, just because of dust. Each little particle of dust becomes a core or center around which a drop of water vapor condenses or turns back to its water form. They tell us that if there were no dust at all in the air, the earth might even become so barren we could not live on it."

Don looked startled. "Is there any danger of that?" he asked. "Where does the dust come from?"

"From a great many sources," answered father. "Salt is blown from the ocean spray; sand is blown from the desert; meteorites that come our way help too. Ashes from volcanoes supply dust also. When a huge volcano near Java was active, it was figured that a vast amount of dust was thrown off in an eruption; some of it must have traveled around the earth three times before it finally disappeared, and for about three years, the sunsets in the temperate regions, where the dust was found, were wonderful in color."

"The dust from city streets counts, too, I suppose," said Don.

"Yes, and the soot from factories, as well as the dust rising from plowed fields. Even the flowers add their bit, through the pollen which the wind scatters," said father.

"Then we must count the wind as another helper," said Don.

"Of course," said Ruth. "The wind heaps up the clouds and gives them their lovely shape, doesn't it, father?"

"The wind helps to form the clouds," agreed father, "but there are many other causes for cloud formation, as there are many other cloud forms than those we have talked of; it is not easy to explain why clouds take the shapes they do. The wind has its part to play, though, or we should have no rains on the land."

"What is the difference between a fog and a cloud, father?" asked Ruth.

"A fog is just a low cloud, one that rests on or near the earth," replied father. "The warm air from the land blows over the sea and becomes chilled. Then the water vapor that is in the air turns back to its water form, or condenses, as we say, and shows as fog. The clouds in the sky show because the water vapor has turned back to its water form high above the earth, when it met a cool layer of air."

"But if the water vapor turns back to its water form, why does it not fall as rain?" queried Don.

"The water in fog or clouds," replied father, "is in such tiny drops that it is more correct to think of them as droplets. You have seen the steam form in wee drops on a cold window pane, have you not?"

"Oh, yes, father," cried Ruth, "and when there was ever so much of it, the tiny drops ran into one another, and made streams of water down the glass."

"That is very much the same as happens in the clouds. In summer we get rain. In winter when the change to the water form takes place below freezing point, we get sleet or snow from the clouds, and frost on the ground instead of dew."

"And hail?" asked Ruth. "It hails in summer."

"Hail is generally rain that froze," said father. "Large hailstones seem to be made up of layers. Probably the hail stones have been carried up and down by different currents of air, and have so had one layer after another added to them."

"I don't believe we can call hail a helper," said Ruth, doubtfully. "Doesn't it often hurt crops?"

"Sometimes it does cut and injure grain," said

father, "but this does not happen so very often. Probably the hail helps more than it harms, and if we cannot quite understand it, we can remember what the psalmist wrote about all these helpers—

'Praise Jehovah from the earth, . . .
Fire and hail, snow and vapor,
Stormy wind, fulfilling his word.'"

"Oh, that's a lovely verse, father!" cried Ruth. "Are there any more verses in the Bible about our helpers?"

"Yes, indeed!" replied father. "You may look for them to-night, but I will give you one more now:

'I know that Jehovah is great, . . .
Who causeth the vapors to ascend from the earth;
. . . In the seas and in all deeps;
Who maketh lightnings for the rain;
Who bringeth forth the wind out of his treasures.'"

"We must learn them, Ruth," said Don, "and then I mean to write them under my cloud pictures in our 'Good Times Book' when we get home."

"That will be fine," said father, "and you will have a good time hunting out other verses too. There are some grand descriptions of clouds and storms in the Bible!"

Something to do:

1. Find or draw pictures, or take photographs, of clouds of different shapes. Mount them and write the name of each under the picture.

2. Find a poem called "The Cloud," written by Percy B. Shelley. Learn to read it well. Note the lovely pic-

tures that the poem makes. Draw, paint, or collect pictures to illustrate the poem.

3. Watch the sunset sky for several nights. Then try to make a sunset picture for yourself, either using water color paints or crayola. You may draw your own sky, color a black-and-white print, or tint a photograph. Put your color on daintily, and suggest the glow; do not try to get it as strong as the real color. Try again and again. You will not be satisfied with what you do, but the trying will help you to see the lovely colors and to remember them.

4. Find and ask your mother or teacher to read to you Carl Sandburg's poem called "Fog," C. G. Rosetti's poem called "Boats Sail on the Rivers," and "April Rain," by Robert Loveman. Which of these poems do you like best? Can you find a poem you like much better? Try to write a rhyme about one of the helpers we have talked about in this lesson.

5. Find a beautiful Bible poem about clouds, wind, or the sky. There is one in Job, and more than one in the book of Psalms.

To learn: Psalm 148. 7-10; *or* Job 37. 9-11.

To read: "Who Has Seen the Wind," a poem by C. G. Rosetti; *or* "I Saw You Toss the Kite on High," by R. L. Stevenson.

LESSON XXIX

NEIGHBORS IN THE SKY

"THE very best part of our camping trip," said Ruth, as she pasted the last photograph in the "Good Times Book," "was sleeping on the desert. The air was so balmy, and the stars were so clear. They looked almost near enough to touch. Why did they seem so near, father?"

"I suspect," answered father, "that it was because we were far from the city dust and smoke, and there was less to shut the stars away from our vision."

"The shooting stars were great," added Don. "I felt as if I were looking at some exhibition of fireworks. I am sorry I did not count them, but I never saw so many in all my life before as I did that one night."

"Jupiter was the biggest star in the sky," said Ruth. "Wasn't he bright that evening?"

"Father," said Don, teasingly, "won't you please explain to Ruth that Jupiter is a planet and not a star?"

"I ought to explain to you, Don," replied father with a twinkle, "that there are no shooting stars."

"Why, father!" exclaimed Don. "You saw them yourself, and talked about them too."

"I saw," replied father, "what people commonly refer to as 'shooting stars,' but they are not really stars at all. Astronomers call them meteors, which just means masses of stone, iron, or other metals.

Such a mass enters our atmosphere, breaking every speed law that man has thought of. It travels, not twenty or thirty miles an hour, but twenty or thirty miles a second. Naturally this terrific speed makes a great friction as soon as the mass enters our atmosphere. The friction raises the meteor to white heat, when it is still seventy or eighty miles away from the earth, and we see the glow. Quite often the mass has been changed to a hot vapor before it reaches the surface of the earth."

"Then how do we know it is made of iron or some metal, if none of them ever reach the earth?" asked Ruth.

"I said 'quite often,' " replied father. "Though meteors seldom fall, wise men have many ways of finding out about these strange visitors, even if they turn to gas. But large meteors have fallen from time to time, and have taught us many things. The little stone in mother's bracelet is said by the Indians to have fallen in such a meteor. That is why it is called *peridot*; *peri* means 'from heaven,' and *dot* means 'a gift.' The Indians think the stone is a gift from above."

"Do the Indians have stories about falling meteors?" asked Don.

"A great many," replied father. "In one of our Western States there is a huge sandy hollow, about which the Indians tell many stories. They say that long ago a great fiery mass fell from heaven on that spot, with loud noises; they believe the mass is buried in the earth. The wise men think that a huge meteor may have fallen there long ago; they suppose that the force and speed with

which it was traveling may have sent it deep into the earth, and that this may have turned the rocks and earth around the place where it struck into sand. They have tried to dig down and find out what lies below the fine sand, but so far all that they learned with certainty is that a mass of rock is down at some depth, a rock so hard that any tool they have yet been able to make is very quickly dulled in the drilling process."

"And has no one ever found a true meteor?" asked Don.

"Yes, indeed!" replied father. "They have been found in many parts of the world, and in varying sizes. They are often surprisingly heavy. A scientist friend of mine has one that would easily be covered by mother's laundry basket. You would think that you could easily move it, Don, if you saw it lying in his laboratory, and you would wonder why the table on which it rests is built so strongly. But if you were to try to rock it ever so little, you would find that all of your strength is not great enough to stir it."

"Tell us about comets, father," asked Ruth. "Are they like meteors?"

"The head of a comet," replied father, "is probably a company of meteors that have come near enough to the sun to feel its pull. As this crowd gets nearer and nearer to the sun, it travels faster, and throws off a vapor-like matter that we call the tail. Sometimes this becomes very long; the comet of 1843 had a tail two hundred million miles long."

"Oh my!" gasped Ruth. "I should think the earth might get hit by such a long tail as that!"

"It has been hit more than once," laughed father. "Twice in the nineteenth century the earth passed through the tail of a comet, and came out not a whit the worse for the experience. We do not know surely, but it is thought the light of the tail may be electrical."

"Will that comet ever come in sight again?" asked Don. "I'd like to see it."

"Some comets," replied father, "make their bow to us quite regularly; others come back at very long intervals, while still others are so uncertain in their movements that no one can feel very sure when they will show in the sky, if they ever do."

"Do comets always mean war and trouble?" asked Ruth anxiously.

"No, indeed!" laughed father. "Such a belief is absurd, now that we know the nature of comets. You can understand how people, in the days before telescopes, and other fine instruments for studying our skyland neighbors had been invented, must have been startled by seeing such strange and brilliant visitors in the sky. It is no wonder they invented all sorts of fanciful explanations."

"Now, father," urged Don, "do tell us about planets and stars."

"To be sure I will!" cried father. "We must set Miss Ruth right on that point this minute!" and he smiled at his little daughter. "We do speak of Saturn, Jupiter, Venus, Mars, as 'the evening star' or 'the morning star'; but, as Don suggests, we are not quite correct in doing so. The four 'stars' that I named, together with Mercury, Uranus, Neptune, and the earth, are much more properly called planets. They do not shine with their own light,

but merely with the light reflected from the sun."

"Are there just eight planets?" queried Don.

"No," replied father. "The eight that I named are sometimes called the major—which means the greater or more important—planets. There are minor, or less important, planets, which are very much smaller. Some of them have been discovered recently, and are invisible to the naked eye. We need not think much about them just now."

"Why is it that planets do not shine with their own light?" asked Ruth, who had been thinking hard.

"Wise men think that innumerable small bodies circling around the sun united to form small planets, and in course of time some of these grew and grew larger by additional material gathered up in their paths. All of them move about the sun in nearly circular paths, and are kept there by gravitation, the same force that makes your ball or an apple fall. They are opaque bodies, and so cannot shine, except as they reflect the light thrown upon them. They differ, too, from the fixed stars, which seem to move either very little or not at all.

"In reality the so-called fixed stars travel with very great velocity and probably in straight lines. The stars are really suns many times larger than our sun, millions of miles from the earth, and from one another, and give us light on account of being changed into burning gases. The planets seem to wander among the stars; the word 'planet' means a 'wanderer.'"

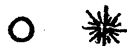
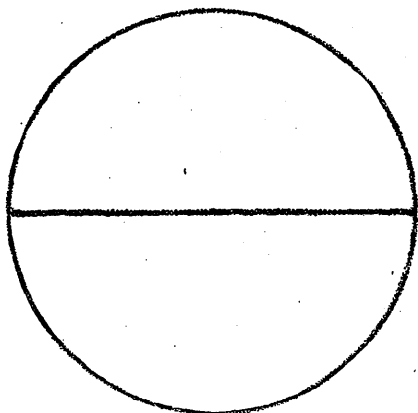
"What do people mean by the solar system?" asked Don.

"The sun with its eight planets, and their moons,

the comets, and the meteors that sometimes come near, make up the solar system," replied father.

"No stars in the solar system?" exclaimed Don.

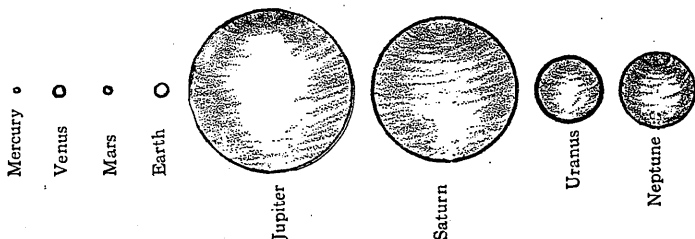
"No stars in the solar system," affirmed father.



How a Planet and a Star Look in a Telescope.

Diameter of Sun, 864,000 miles
Diameter of Earth, 8,000 miles

It would take over one hundred earths laid side by side to stretch across the diameter of the sun.



THE EIGHT PLANETS COMPARED IN SIZE

"All the stars lie outside of this and are enormously farther away from us than the most distant member of our own group. An astronomer has said, 'to travel as fast as a ray of light which rushes through space at

the rate of eleven million miles a minute, it would take about eight minutes to reach the sun, but to reach Sirius, the dog star, a bright star, and one of the nearest to the earth, it would take over eight years. And when we got there we could not land because it is thirty-three times brighter than the sun.' ”

“Nor is that all. Some stars are so far away that we do not try to tell their distance in miles. We say they are so many ‘light-years’ away; that is, we mean that it requires years for their light to reach us.”

“Doesn’t it make us feel little?” asked Ruth.

“It certainly does!” agreed father. “That is just what the psalmist was thinking when he wrote:

‘When I consider . . . the work of thy fingers,
The moon and the stars, which thou hast ordained;
What is man, that thou art mindful of him?’ ”

“Do you suppose people are living on any of the stars or planets?” asked Ruth.

“Astronomers agree,” replied father, “that the stars are so very hot that life cannot exist on them. As to the planets there may be a different answer. Uranus, Saturn, and Neptune are the most distant and are probably too hot for life. Mercury is so near the sun it is hard for us to be sure just what does happen there, but it is thought that the same side is always turned toward the sun. This must mean that the bright side is always very hot, while the dark side must be colder than we can imagine. We cannot be sure about Venus, either, as the surface is so bright it is difficult to find any marking that shows if the same side is

turned to the sun always or not. Jupiter is supposed to be red-hot. Saturn is believed to be a mass of vapors and gases, whirling around at a most astonishing speed. It has ten moons, and a great belt of meteorites miles deep and many hundred miles wide. It is a safe guess that there is no life there."

"That leaves Mars as the only chance," said Don, checking off on his fingers. "Is there life there?"

"Again we cannot be certain," replied father. "It is thought that Mars cooled long before the earth, and that it has water and air. There can be seen on its surface a curious pattern of straight lines which many astronomers have thought to be canals made by inhabitants of Mars to carry water over the surface. Other wise men think any life on Mars is quite impossible."

"I should think, with all the fine telescopes we have to-day, someone would be able to settle the question," said Don.

"You must remember," said father, "that Mars never comes nearer than thirty-four million miles, and then only once in every fifteen or seventeen years. The best photographs that can be taken are very small, and so students must rely on the human eye, and it is very easy to disagree as to just what these eyes see."

"Where did the stars get their names?" asked Ruth.

"The Romans and the Greeks gave many of the names by which we know the stars," answered father. "Mars was named after the Roman war god. But long before ever Rome or Greece was known, the Arabs, the Chaldeans, and many others

knew the stars quite well. They traced out imaginary figures in the heavens, from star to star, and told their tales and myths about them. You will like to look up some of these old tales, and then to find the stars in the sky and to know them by name. Best of all, you will like to study the stars from the Bible, and to learn the splendid verses that tell of them. The starry host was well known to the writers of the Bible, and they were always calling the thoughts of the people to the splendor and the power of God as it was shown through the works of his hands in the heavens."

"I know a fine verse to start off with," cried Ruth.

"The heavens declare the glory of God;
And the firmament showeth his handiwork.'"

"I have another too," added Don. "It is in Job, and this is the way it goes:

"Canst thou bind the cluster of the Pleiades
Or loose the bands of Orion?'"

"That's a fine one!" agreed Ruth. "Let us try to see how many verses we can find, and put them in a Bible star book."

"A good idea!" said father, heartily. "'The heavens shall declare his righteousness,' the Bible tells us, and I know of no more wonderful way of studying the glory of God than through his great lights, the sun, to rule by day, and the moon and stars, to rule by night."

Something to do:

1. Get a map of the sky for the season of the year at which you are studying this book. From this learn the names of the morning or the evening stars, and the

brightest constellation. The first clear night, go out of doors after darkness has come and find these stars in the sky.

2. If it is possible for you to do so, arrange for a visit to an observatory, to look at the stars through a telescope.

3. Divide your class into groups, and let each group choose a constellation for their special study. Learn the story of its name. See if you can find a mention of the constellation in the Bible. Commit to memory these verses, or other verses about the stars. Plan a Star Night for your grown-up friends, to whom you will tell the star stories, repeat your star verses, and point out the stars in the sky.

To learn: Psalm 104. 19; *or* Psalm 19. 1-6.

To read: "Daisies," by Frank D. Sherman.

Praise ye Jehovah.

Praise ye Jehovah from the heavens;

Praise him in the heights.

Praise ye him, all his angels:

Praise ye him, all his host.

Praise ye him, sun and moon;

Praise him, all ye stars of light.

Praise him, ye heavens of heavens,

And ye waters that are above the heavens.

Let them praise the name of Jehovah;

For he commanded, and they were created.

—Psalm 148. 1-5.

LESSON XXX

A STORY OF THE ROCKS

Where wast thou when I laid the foundations of the earth?
Declare, if thou hast understanding.
Who determined the measures thereof, if thou knowest?
Or who stretched the line upon it?
Whereupon were the foundations thereof fastened,
Or who laid the cornerstone thereof?

—Job 38. 4-6.

"WHO would like to ride with me to Blue Ledge?" asked grandfather one bright June morning, as he came upon Don and Ruth busy at work helping grandmother.

"Oh, I would, I would," they cried at once.

"I am going out in the farm wagon to bring a load of gravel to spread on the garden walks, and you may come with me," smiled grandfather. "Get the small shovels and a trowel from the tool house, Don, and we will get a sack or two of mold from Woody Knoll on the way back. You will be glad to have some for your new flower beds, I know," he said, turning to grandmother.

"Indeed I will!" agreed grandmother. "And won't you bring a big box of sand from the cove for my rose cuttings, too?"

"Nothing easier!" said grandfather, tossing a stout box into the wagon. "Ruth, you will find a tin bucket handy to use in helping us fill this!"

In a very short time grandfather, Don, and Ruth, with tools safely stowed in the back of the wagon,

waved a good-by to mother and grandmother and drove gayly out of the yard. Once they were well on their way, Don turned to grandfather, saying:

"Grandfather, Ruth and I have been wondering about ever so many things this morning, and we have a hundred questions we would like to ask you."

"As many as that?" asked grandfather, pretending to be much troubled.

"Perhaps not quite a hundred," grinned Don, "but certainly a great many."

"Let us have them, one at a time," said grandfather, "and we will try to find the answers."

"You know," began Don, "that Ruth and I spent ever so long gathering nice, round pebbles to make into borders for grandmother's flower beds. We want to know why they are so round and smooth. They look as if they had been polished."

"They have," said grandfather, quietly.

"Why, grandfather!" cried Ruth in surprise. "We picked them every one along the side of the creek just two or three days ago! When could they have been polished?"

Don, catching the twinkle in grandfather's eye, shook his head. "Grandfather does not mean just what you think, Ruth," he said, "but I do not understand what he does mean."

"Let me ask you a question or two," returned grandfather. "Did you ever go up the creek, beyond the place where you gathered your pebbles?"

"Oh, yes," said Don. "We went a long way up in the spring when we were trout fishing with father."

"Are the pebbles on the upper banks just like those that you picked up?"

"There are few pebbles along the upper banks,"

said Don, slowly, as he tried to recall just what the stream looked like. "The farther up we went the bigger the rocks were."

"What is the difference between a rock and a pebble?" asked Ruth. "Isn't a pebble just a little piece of rock?"

"Oh, grandfather, I believe I can answer that myself!" cried Don. "A pebble is a little rock, and a boulder is a big rock; is that right?"

"Quite right!" agreed grandfather.

"How big is a boulder?" asked Ruth.

"About as big as a—well, about as big as one of those nice little melons we had for breakfast, I should say," ventured Don.

"Ho, ho, ho!" laughed grandfather. "That is a very good way to remember! And what will you say about pebbles? When does a bit of rock get too small to be a pebble?"

"If it is smaller than a pebble, it would be—why, it would be a grain of sand," said Don, after a minute's thought. "Some sand is pretty coarse, grandfather! How would it do to say that pebbles are not bigger than the peas Ruth shelled for dinner?"

"Peas and melons—pebbles and boulders!" cried Ruth. "I can remember that!"

"Yes, indeed!" said grandfather. "Sometimes we call small boulders, those that can be lifted with one hand, cobbles, or cobblestones, but you will get on very well in your talk of rocks if you recall pebbles and boulders. Let me ask you another question: Why are the boulders on the upper parts of the creek and the pebbles on the lower? Wait a minute and I will ask you still another question.

Why is there only sand in this cove, with the pebbles all a half-mile higher up? Why is the meadow a mile below fine soil, much finer even than this sand?"

"No fair, grandfather; no fair!" cried Don. "You told us, 'one question at a time,' and you have asked two or three!"

"So I did!" laughed grandfather. "But I think I will not take any of them back, for one fact pretty nearly answers all of them. Before we get out to fill our box with the sand look up and down the creek; see how the water runs; think hard about it, and I am sure you will be able to study out for yourself the reason for the sizes of pebbles you find in the different places." And grandfather climbed down from his seat and began to pile up the sand with his big shovel while Don and Ruth filled their pails time after time and emptied them in the box, till it was quite full. As they took their seats to drive on again Don asked, "Grandfather, are there more pebbles down below because the pebbles are smaller, and the water can carry them farther?"

"Exactly!" agreed grandfather.

"And the sand is lower down the stream because it is lighter than the pebbles!" added Don.

"But the mud is lighter than the sand," said Ruth, "so it is carried still farther!"

"The creek is wider here in the cove, and the water runs slowly. Has that anything to do with the dropping of the sand at this place?" asked Don.

"Indeed it has," said grandfather. "The narrower a channel is, the faster will the water run. The faster the water runs, the more it can carry.

If we were to confine the water of the creek at the cove into a smaller space, it not only would not leave that nice bed of white sand for our use but it would carry down many of the pebbles that it dropped before it came around the bend. But here we are at Blue Ledge."

"What a queer-looking rock!" cried Don, leaping to the ground, and laying his hand on a great blue-gray mass that towered many feet above the roadway. "Why, Ruth, look! It is all in layers; you can pick bits of it off."

"It looks like our blackboard at school," said Ruth, as she fingered some of the thin flat bits, with their sharp edges and corners.

"It is much the same as your blackboard," agreed grandfather. "It is slate, of a common sort. One of its oddities, but one which makes it very useful, is that it can be cut in thin flat sheets, and made very smooth."

"Oh, that is why people use it for roofing and for blackboards," cried Don.

"But I shouldn't think it was good at all for walks!" declared Ruth, looking down at the mass of sharp-edged little pebbles on which she was standing.

"Why not, Ruth?" queried grandfather, smilingly.

"Look at all these sharp edges!" exclaimed the little girl. "They won't hurt my strong play-shoes, but just think of mother's walking on them with her kid slippers, or grandmother's going down the walk in her pretty black satin pumps! They will be ruined!"

"Do you remember how the gravel on the walk looks?" asked grandfather.

"Those pebbles," asserted Ruth, "are not like these at all; they are all rounded on the edges; they can't cut shoes."

"Perhaps they have been polished," twinkled Don.

"They have," answered grandfather, "and in much the same way that your bigger pebbles were polished." Then, as he saw the puzzled look on Don's face, he added:

"It is quite a riddle, isn't it? Come and I will show you how it is done." And following a winding road, grandfather led the way around the ledge and down to its very foot, where a lovely little lake continually washed the mass of gravel that had fallen from the rock. Don stooped to run his hand through the gravel.

"Why, these pebbles are smooth, as smooth as if polished!" he cried. "I see," he added, quickly. "Ruth, the water moves them back and forth on each other, and all the rough edges are smoothed off!"

"Right!" agreed grandfather, beginning to fill the sacks with the smooth pebbles. "The rough gravel at the top of the cliff may some day be as smooth as this is now. You can imagine how it has been made—water ran into the cracks of the rock, and froze in the cold of the winter-time. The ice and frost cracked off bits of rock. This goes on in every cold season. By and by the mass of gravel gets so heavy that it slides down. Heavy rains help to wash it into the lake. The waves, playing back and forth on it, polish the pebbles by pushing them on each other. Even on a quiet day like this there is some wave action, but at times when

the winds are high the waves are much stronger, and the polishing goes on pretty fast."

"The creek pebbles are polished in the same way, then," said Ruth, "only they rolled against each other and the big boulders too, as they moved down the stream."

Grandfather agreed.

"The boulders are being made into pebbles, the pebbles are being made into sand," said Ruth, "is the sand being made into anything else?"

"Why, of course," Don almost shouted, as the truth suddenly flashed on his mind. "The sand is being made into clay and mud and silt. Is all soil made of rock, grandfather?"

"Think a minute and answer your own question," was grandfather's reply.

"The Indians taught the Pilgrim Fathers to put a fish in each hill of corn for fertilizer," said Ruth. "Haven't animals helped a great deal in making soil, grandfather?"

"Indeed they have," said grandfather. "Our soils would lack much of their richness if they had not been helped by animal life. There is another important contribution to soil making that I will show you when we get to Woody Knoll."

"Oh, 'humus!' " cried Don. "That was another question I was going to ask!"

A short distance from Blue Ledge was a rough rocky knoll or low hill, covered thickly with trees. Grandfather thrust his shovel into the soft earth, cutting away a section to show the layers of which it was made. Don flung himself down to look closely.

"Dead, dry leaves from last summer on top," he said. "Then there are leaves almost all decayed;

next, fine black soil. Below that, the soil is partly black and partly sandy."

"The decayed vegetable matter is the humus," explained grandfather. "Where you find the mixture, the humus has been carried down into the fine sand. What comes below the sand?"

"The sand gets coarser and coarser till it is almost gravel," replied Don.

"That is the subsoil," said grandfather, "and if we went down deep enough, we would by and by come to rock of one kind or another, according to the locality in which we might be digging."

"How were the rocks made in the first place, grandfather?" asked Don.

"That is a question that men asked a great many years, and they looked for the answer a long time. Hard study and hard thinking have made it plain, but it will take you a long time to understand all about it. One way in which rocks were made was through the action of water. You may call such rocks water rocks. Other kinds of rock were the result of great heat; they are called fire rocks. Both water and fire rocks have often been acted upon by pressure, or heat, or wearing away and building up by water, and, quite properly, they are called by a name that means changed rocks."

"Did it take a very long time?" asked Ruth, wonderingly.

"Yes, a very long time," replied grandfather. "Someone has said it takes a million years to make a grain of sand. Some people suppose that the earth was much longer in taking form. We cannot be sure, nor does it make much difference. You know the Bible says, 'a thousand years in God's

sight are but as yesterday when it is past.' The important thing for us to remember is that the building up and the wearing down of the rocks, the slow making of the soil, are all the work of God's hands. It is a part of the orderly working out of his great plan."

Something to do:

1. Explain what part animals, trees and plants, and running rivers have had in making the earth.

2. Climb a hill with your teacher or some grown-up friend, and ask him to explain to you how the hill came to be there.

3. Make a collection of river-polished pebbles.

4. Make a collection of small pebbles, sand, and silt or clay. Put a small amount of each in a glass, and cover with water. Stir the contents of each glass thoroughly. Note in which of the glasses the water "settles" or clears most quickly. Why is this so?

5. Try to find a place where a cellar is being made, or a hill is being cut down to make a road. Look at the soil, and see how many varieties you can find.

6. Watch a streamlet after a rainstorm, and see how many things you can prove for yourself about the carrying and carving power of running water. Is it the water that does the cutting? Is the cutting done by the sand, pebbles, or other material that the water carries? Can you prove this?

7. Read Psalm 147. 5. Does this seem to you a fine verse to sum up the wonders of earth-making by God's hand?

To learn: Psalm 104. 1-9; or Isaiah 40. 12.

To read: "The Wonderful World," by William Brighty Rands.

LESSON XXXI

WATER AND ICE

He sendeth out his commandment upon earth;
His word runneth very swiftly.
He giveth snow like wool:
He scattereth the hoarfrost like ashes.
He casteth forth his ice like morsels:
Who can stand before his cold?
He sendeth out his word, and melteth them.
He causeth his wind to blow, and the waters to flow.

—Psalm 147. 15-18.

"GRANDFATHER," said Don one day, "how did that great rock ever come to the middle of your big meadow? There is not another rock of any size in sight within several miles."

"It was brought there by the ice," answered grandfather.

"By the ice!" gasped Don, in amazement.

"Many, many years ago," replied grandfather, "more than half of the north temperate zone was covered with a great mass of ice. This ice, moving down slowly, carried with it great bowlders, which were dropped here and there as the ice melted. The big rock in the meadow is almost surely one of them."

"Where did the ice come from, grandfather?" asked Ruth.

"From the vast quantities of snow that fell," answered grandfather.

"I thought you said it was ice," objected Ruth.

"The glaciers were formed of ice that came from

the snow," responded grandfather. "Do you remember what happened to your snowballs last winter, when you kept packing and pressing them in your hands?"

"Oh, yes," said Ruth. "They grew hard and almost as solid as ice."

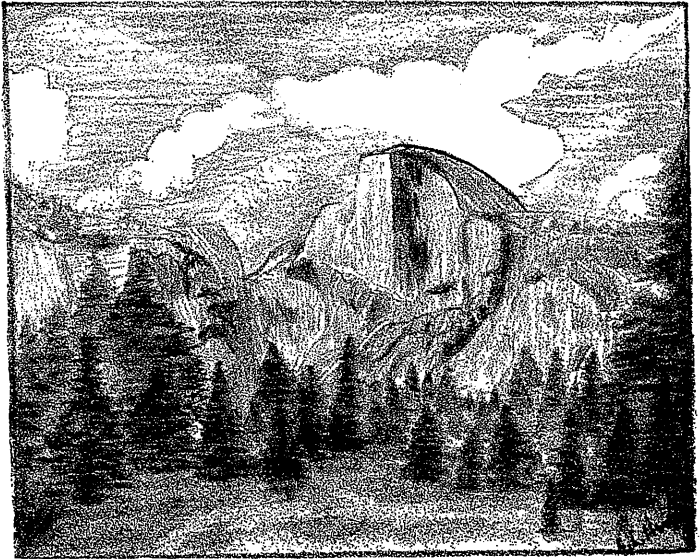
"Almost the same thing happened in these old glaciers," went on grandfather, "as men can tell by studying glaciers to be seen to-day. The snow on top is light and fluffy, and in separate flakes. As the amount of snow increases, its weight presses on that below and begins to pack it. Then the snow is grainy, like sand. As the weight of snow above grows greater, the grainy kind turns to ice, clean, clear blue ice. You can see that boulders, rocks of smaller size, sand and earth that fall from cliffs and ledges on the ice, will be carried along with it until the ice melts and drops its load. That is how our big rock came to be planted in what is now our meadow."

"But, grandfather, what happened that the ice melted? Or what happened before that, that the glaciers were made? We do not have them now," said Don.

"That is quite true," agreed grandfather, "and many people have puzzled over the fact and tried to account for it, though no very satisfactory explanation has ever been given. It is probable that ages ago the climate was different over this region. However that may be, there is little doubt that the glaciers did their work; we can see many sure traces to prove that this is so."

"What was their work?" asked Ruth with much interest.

"The answer is a very long one," said grandfather. "To put it in the shortest possible form, it was to make the earth ready for God's creatures to live on it. It was to make the earth richer and lovelier. The glaciers smoothed down mountains.



HALF DOME, YOSEMITE VALLEY

The Glaciers Plowed Out This Valley and Polished Its Sides.

They built up hills. They carved out lakes. By rearranging drainage they forced rivers to seek new channels. Often these channels ran over rock ledges that had been buried under the masses of earth carried by the glacier. When the river cut down through this to the rock, the rock wore away more slowly, and so falls and rapids were made,

and man was supplied with the water power for his factories."

"What happened to all the people living when the glaciers came?" asked Ruth, anxiously.

"Undoubtedly there were fewer people on the earth in those days than there are now," replied grandfather, "but we know man was living then, for his stone tools have been found in the glacial gravels. The coming of the glacial age was probably slow, and no doubt man retreated from it, and went to the south where he found a warmer place to live. Animals probably did the same. Plants would tend to push to warmer climates also, but more slowly than animals that could move as they wished. When the ice began to melt, plants that love the cold would have to follow it, or begin to grow up the sides of mountains. There is little question that the explanation for some of the big puzzles in plant and animal life is found in just this fact."

"Glaciers are makers of icebergs too, are they not, grandfather?" asked Don.

"Yes, whenever they extend to the ocean," replied grandfather. "In Greenland and in Alaska, for example, the weight of the snow pressing forward, and the natural slide of the glacier down the slopes press it out over the sea. Here, by the action of the waves dashing against it, and partly, too, by its own weight, great masses of ice are broken off from time to time, and go floating away like a huge palace or mountain of ice. It was an iceberg so formed on the Greenland coast that sunk the great Titanic a few years ago."

"What happens to the bergs finally?" asked Ruth.

"They float along on the ocean currents till they are carried into warmer regions and melt and disappear," said Don. "What happens to the melting ice when the glacier is not on the seashore, grandfather? Does it form a river?"

"Yes," replied grandfather, "and there is one odd thing about such streams that is so marked you never forget it, once you have seen it—that is the color, which is a curious milky shade. Can you guess what makes it?"

"It must be something that the stream carries with it," suggested Don.

"Yes," agreed grandfather, "it is the sediment, which is made up of fine particles of fresh rock that has never been weathered. These rocks are generally white in color, and so the particles make the river look milky. It is one of the most striking things about the streams in the Canadian Rockies, which you will see for yourself some day, I hope."

"Glaciers are mills that grind up earth-flour," said Ruth, "and the rivers carry the flour down from the mountains and put it where it can be used."

Grandfather smiled at the little girl's fancy. "That is one way of telling the work of the glaciers," he said. "It has been going on for more years than we can count. The rivers carry not only the sediment given them by the ice, but much that they pick up along the way, from the banks through which they flow and the soil carried into them by smaller streams. Tell me what becomes of all this fine sediment, Don."

"It must be dropped by the river somewhere," said Don, thoughtfully. "But I am sure this won't happen until the river begins to run quite slowly,

and that will be—why, that must be away down toward its lower end, just before it runs into the sea, in most cases.”

“That is true,” agreed grandfather, “and I am sure you will think it very curious when I tell you that some rivers have built up their beds so high at or near their mouths that the river is really higher than the level ground about it!”

“Oh, I should think it would run over and flood the land!” cried Ruth.

“It does sometimes,” agreed grandfather, “and it would do so much oftener if men had not built artificial banks to keep the river in place. There are parts of the Mississippi River that are so much higher than the country around that if you are to take a steamer for a trip you do not go down to the river, but you climb up to it!”

“I saw a picture of that just the other day,” cried Don, “but I thought it was a made-up picture, like the ones of the big fruit or the huge fish that are made for jokes!”

“No, indeed!” said grandfather. “Rivers are strange and powerful forces, and one cannot tell at once all the queer facts about them. Do you know that rivers sometimes get lost, and that some rivers are really upside down?”

“Oh, grandfather, what do you mean?” asked Ruth.

“There are rivers in the dry regions of our country that start out from the mountains as does any ordinary river, but when they get down into the sandy places, they just disappear; they are really lost as far as you and I can tell. The water has run down through the sand, and it probably finds its way to underground reservoirs.”

"And the upside-down rivers, grandfather?" prompted Don.

"Where is the sandy bed of a river with relation to the water?" asked grandfather, with a twinkle.

"Why, under the water, of course!" cried Ruth.

"And what would happen to you if you fell into the river?" asked grandfather.

"Why, I'd get wet!" laughed Ruth.

"Then if I should take you to a river whose sandy bed is over the water instead of under it, and show you that you would not get wet, but hurt, if you fell in, you would think it fair to call that an upside-down river, wouldn't you?"

"Yes," agreed Ruth, "but are there any such rivers?"

"Indeed, there are, in some parts of our own country," asserted grandfather. "If you go to get water from such a river, you take a shovel, and dig a hole in the sand. After a time, the water creeps up into the hole, but you will never find it unless you dig for it!"

"I think I like our own shining right-side-up rivers best," said Ruth.

"Grandfather, I have been thinking of those lost rivers," said Don. "Do they never get found again?"

"Sometimes, yes," answered grandfather. "Such streams may run underground for a long distance, till they strike a layer of rock through which they cannot pass. Such a layer may be tilted up till it comes to the surface of the earth in places, and the water may follow the tilt and come pouring out."

"Oh, then we'd have a spring!" cried Don. "I never thought of that!"

"Yes, and suppose the rock that the water followed happened to be heated rock?" asked grandfather.

"The spring would be a hot spring," said Don.

"Quite right," agreed grandfather, "and if it chanced that the rocks were hot enough to make the water boil, and that the opening was small enough to give some pressure, the spring might throw out its contents with much force, and we would have a geyser, such as is common in Yellowstone Park. You remember you have a number of pictures of these geysers that Uncle Will sent you."

"I mean to see the geysers some day," declared Don, "and the Grand Canyon, too. Is that really the work of water, grandfather?"

"So the wise men tell us," replied grandfather. "For thousands of years, the river has been working away at cutting down the rocky walls, till its channel is now a mile or more below the surface. You see what can be done by keeping always at it!"

"What a long time it has taken to make our earth, and how many tools have been used in doing it!" said Don. "Glaciers and rocks, water, ice, snow, frost, all have helped, haven't they?"

"Yes, God has used them all," replied grandfather. "His plans are wonderful, and we, as we find them out bit by bit, feel as did Job, when he said: 'Behold God is great, and we know him not. The number of his years is unsearchable.'"

Something to do:

1. Find a copy of the National Geographic Magazine for June, 1926, and read the story of the icebergs.

2. Copy a map of the United States and Canada, and mark the parts that are thought to have been once covered by ice. Ask your teacher to tell you how the rivers emptied into the ocean before the Ice Age, and trace those ways with a red crayon. How did the coming and going of the Ice Age change the rivers?

3. Find a stream that has carried away the earth from the sides of its channel. If possible, follow the stream till you come to the place where this material was deposited. Is it in a pool or shallow place? Take a shovel and cut down through the deposits as far as you can, and write carefully in your notebook just what you see.

4. If you are a city child, it may be difficult for you to carry out Number 3. In that case, try to pile up a heap of sand in a shallow box in the schoolroom or on some concrete floor. Provide some way of caring for the water, so that it will run off without harming anything, and then sprinkle gently and plentifully your sand. You may learn some very interesting lessons as to how water carves hills and carries earth materials by doing this!

To learn: Job 36. 26.

LESSON XXXII

COUNTING UP: A REVIEW

**The earth is Jehovah's and the fullness thereof;
The world, and they that dwell therein.**

—Psalm 24. 1.

FOR many weeks now we have been thinking and studying about the great Wonder-world in which God has put us. This last lesson will be a good time for us to count up some of the things we have learned.

You know we have talked of the creatures of God's world as neighbors. What does that mean? If you will go to the dictionary, you will find out that "neighbor" once meant "near-dweller," the people who live not far from you. Do you think it means more than that now? How did the word come to have a fuller meaning than just the place where people live? If you think a moment, you will remember what Jesus said about neighbors—"Thou shalt love thy neighbor as thyself." What a truly happy and wonderful world it will be when all of us learn to do that!

Of course when Jesus told us to love our neighbors as we love ourselves he was talking about men and women neighbors, and boy and girl neighbors. But I am sure that he meant more than that too. Jesus loved the flowers, and spoke of the lilies and the grass. He talked of the foxes and the birds. He said that not even a little sparrow fell to the ground that God did not know of it.

Are you not very sure that Jesus wishes you to treat with kindness all of God's creatures? Do you not feel very certain that it is a part of God's will for you to know all that you can about the strange and interesting creatures he has made as helpers in preparing and keeping the earth as a beautiful home for everyone?

Let us begin our counting up by naming some of the creatures that we often forget, and by telling what they do for us that they should be called our "neighbors."

What facts about "back-yard neighbors" did you learn for the first time in this class? What new facts have you learned since you read those chapters in the first section? Which of these neighbors do you think is the most helpful? Which is the most interesting? Which do you know best? Which Bible verses about these neighbors do you like best? Why?

How many feathered friends have you made since you began to study these lessons? What is the most interesting story you have about one of them? How many pictures can you show of their work as good neighbors? Repeat all the Bible verses about birds that you know.

Tell the story of your garden. What was the first neighbor you met there this season? Perhaps your garden was only as big as a single tin can. Perhaps it was even smaller. I once had a lovely garden planted in six half-egg shells, and it was great fun to care for it, and to watch it grow. If you have had such a garden, perhaps you mean now to introduce some sick child, or some lonely shut-in to your neighbors, and help to know a

flower or a plant as a friend! See if this is not just the very best of fun!

Of all your four-footed friends, which one do you think is the strongest? the most interesting? the most useful? How many new four-footed friends have you made this year? Write a story about one of them.

Have you tried to draw pictures of some of the skyland helpers? It is great fun to make a "cloud census." You must watch the clouds every day, and then with chalk laid on the side, or with a soft pencil on paper, try to copy some of the shapes, and then name them. You will soon have a rare and valuable collection of cloud friends. Perhaps you may like better to try coloring the pictures with water colors; and if you do not satisfy yourself the first time, or the second time, or the third time you try, then recall the old verse, and "try, try again!"

Now, we have said a good deal about what our neighbors do for us. What can we do in return for our neighbors? We surely will never be quite happy to be takers always and givers never! Of course it is absurd to think we can make returns to some of our neighbors, such as the clouds, for example; but we can do better, we can make returns of thanks and praise and loving wonder to the Father who gave us these helpers. We can let every sight of them take our thoughts to him. We can look sharply for ways in which each of us may make the world a little more beautiful, a little more comfortable, for others. What can you do, just where you live, and with just what you have, to show that you are as good a neighbor to others as you have found others are to you?



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JAN 25 '36 JAN 18 '38	Bower 306
AUG 21 '39 NOV 19 '41	Chave Counter Res.
NOV 19 '41 MAR 2 9 1943	R E Seen
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